Medicinal Plants of the World

Medicinal Plants *of the* World

Chemical Constituents, Traditional and Modern Medicinal Uses

Volume 2

By

Ivan A. Ross

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Preface

This second volume of the series *Medicinal Plants of the World* contains information on 24 plant species and 3225 references. It follows the pattern of the previous volume, which was warmly received in the scientific communities around the world. The reviews in the leading scientific periodicals commended the plan of work and offered suggestions for improvement. I have made use of those suggestions in this second volume of *Medicinal Plants of the World*, and I appreciated those suggestions since they were an encouragement to me in the continuation of this work. After learning of the need for more information regarding medicinal plants, I felt obligated to intensify my efforts to continue this work speedily, while at the same time maintaining its essential standards and character as a standard reference book.

Readers of the previous volume have pointed out the need for an index and for references to the chemical constituents. These needs have been met in this volume. There were also questions about the criteria for the choice of the plants. The volume of rapidly proliferating literature made it very difficult to decide on the plants to discuss. The criteria used in final selection of plants were the distribution and uses of the plant in developing countries where they are needed as a primary source of medicine, the amount of information available on the plant, and consumer interest.

I am grateful to all those who have contributed to this book. I count myself as greatly privileged to have their collaboration since their wisdom has made this possible. I wish to record my grateful appreciation of the cooperation that has been extended to me by the administrators of the NAPRALERT database at the University of Illinois, Chicago, IL, USA; The New York Botanical Garden, Bronx, New York, NY USA for access to the herbarium, and to Mrs. Richter and the staff at Richter's, The Herb Specialists, Goodwood, Ontario, Canada for their hospitality while photographing some of the plants in this volume. My appreciation goes to scientists around the world for their dedication to the exploration of the medicinal values of plants and for sharing their knowledge. Thanks also to those colleagues and friends who have helped with criticism and suggestions. I am especially grateful to Danna Owens and Louise Joseph for their work on the manuscript, and to Jennifer Carroll for editing the project.
I sincerely hope that this series will help promote healthier nations, a better appreciation and utilization of plants, and more research to further medicine.

As in the case of the previous volume, every effort has been made to present all available information up to the time of publication.

Again, suggestions for improvement will be gratefully received and made use of in subsequent volumes.

Ivan A. Ross

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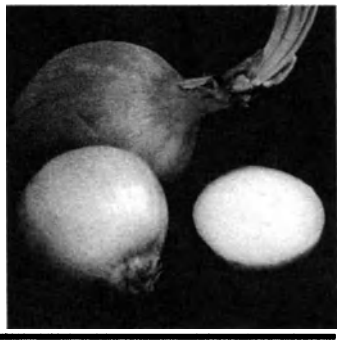
L.



Common Names

Basal	Jordan	Oignon	Vietnam
Basal	Yemen	Onion	Europe
Basl	Arabic Countries	Onion	Netherlands
Basl	Saudi Arabia	Onion	Brazil
Bassal	Egypt	Onion	Egypt
Bermuda onion	USA	Onion	Greece
Bsal	Morocco	Onion	Guyana
Ceba	France	Onion	India
Cebo	France	Onion	Iran
Cebolla morada	Mexico	Onion	Japan
Cebolla	Guatemala	Onion	Kuwait
Cebolla	Nicaragua	Onion	Mexico
Cebolla	Peru	Onion	Nepal
Cepa bulb	Kuwait	Onion	Nicaragua
Cepolla	Italy	Onion	Tanzania
Cipolla	Italy	Onion	USA
Common onion	Kuwait	Onion	USSR
Cu hanh	Vietnam	Piaz	Iran
Hom khaao	Thailand	Piyaj	Fiji
Hom yai	Thailand	Piyaj	India
Hua phak bua	Vietnam	Piyaz	Fiji
Hu-tsung	China	Pyaz	India
I-bsel	Tunisia	Pyaz	Nepal
Inyan	Nicaragua	Red globe onion	USA
Khtim	Vietnam	Sebuya	Nicaragua
Kitunguu	Tanzania	Shallot	China
L'oignon	West Indies	Sibuyas	India
Loyon	West Indies	Sogan	Turkey
Madras onion	West Indies	Spanish onion	USA
Oignon	Rodrigues Islands	Vengayam	India
Oignon	France	White globe onion	USA
Oignon	Tunisia	Yellow onion	USA

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BOTANICAL DESCRIPTION

A herbaceous biennial monocot with leaves that consist of a blade and sheath; the blade may or may not be distinctive. The sheath develops to encircle the growing point and forms a tube that encloses younger leaves and the shoot apex. Young leaves grow up through the center of the sheath of the preceding leaf. Leaves are initiated alternately and opposite each other. The leaf blades are tubular, slightly flattened on the adaxial side, and although hollow, are closed at the tip. Bulbs are uniform in shape, size, and skin color. Shapes range from spherical to nearly cylindrical and include flat and cone-like bulbs. Skin variation is considerable, as is skin color, which may be white, yellow, brown, red, or purple. The terminal inflorescence develops from the ring-like apical meristem. Scapes, one to several, generally elongate well above the leaves and range in height from 30 cm to more than 100 cm. The scape is the stem internode between the spathe and the last foliage leaf. A spherical umbel is borne on each scape and can range from 2 cm to 15 cm in diameter. The umbel is an aggregate of flowers at various stages of development; usually it consists of 200–600 small individual flowers, but this number can range from 50 to more than 1000. Flowers are perfect, having 6 white petals, 6 stamens, and a 3-carpel pistil. Seeds are black, irregularly shaped, and relatively small; about 250 seeds weigh 1 gram.

ORIGIN AND DISTRIBUTION

An old species that originated in central Asia, the onion was cultivated in India about 600 BC. It is now cultivated throughout the world. Although temperate in origin, it has been bred to adapt to the tropics.

TRADITIONAL MEDICINAL USES

Arabic countries. The dried bulb is used orally as a contraceptive, externally as a liniment, and as an emmenagogue in the form of a pessary in Unani medicine[AC0265].

Brazil. Hot water extract of the fresh bulb is taken orally to treat hypertension or to induce diuresis[AC0294].

Egypt. The roasted bulb is used intravaginally as a contraceptive, before and after coitus[AC0338].

Europe. The bulb is taken orally to induce menses[AC0105].

Fiji. Fresh bulb juice is applied ophthalmically to improve eyesight; aurally for earache (juice warmed with coconut oil is dropped in the ear). The fresh bulb is eaten raw with salt for stomachache[AC0295].

Germany. Fresh bulb juice is used externally as an anti-inflammatory agent on insect bites and for bronchitis[AC0288]. Hot water extract of the bulb is taken orally to induce miscarriage[AC0101].

Greece. Warm bulbs are applied externally to treat furuncles[AC0161].

Guatemala. Hot water extract of the dried bulb is used externally for wounds, ulcers, bruises, sores, skin diseases, irritations and eruptions, erysipelas and burns[AC0318].

India. The bulb is taken orally as an emmenagogue[AC0104]. The hot water extract is taken orally by women as an emmenagogue[AC0344]. Butanol extract of the bulb is taken orally for asthma. Hot water extract of the bulb is taken orally by men and women as an aphrodisiac. Butanol extract of the bulb is taken orally as an expectorant and diuretic[AC0223]. The dried seed is used as an abortifacient; 3 parts of the seed, 3 parts of *Punica granatum* root, 2 parts of *Cajanus cajan* and red lead oxide are taken with honey. For abortion, the vaginal region is fumigated with feces of wild pigeon and seeds of *Allium cepa*[AC0298]. Hot water extract of the seed is taken orally as an emmenagogue[AC0309]. Fresh fruit juice, mixed with the juice of *Achyranthes bidentata* leaves is taken orally every 2 hours for cholera[AC0284]. Hot water extract of the fresh bulb is taken orally for diabetes[AC0118], dysen-

tery and fever[AC0270]. The leaf juice is administered ophthalmically to treat jaundice[AC0170].

Italy. The bulb is taken orally for menstrual and uterine pains[AC0322]. Decoction of the dried shoot is taken orally as a cicatrizing agent and to treat insect bites[AC0331]. Hot water extract of the dried bulb is used for inflammation[AC0193]. The decoction is used externally as a cicatrizing agent[AC0331]. The raw bulb is eaten to improve eyesight[AC0322]. Wine extract of the fresh bulb is taken orally for renal function and urinary disease; externally it is used for boils and whitlows[AC0325]. The bulb is eaten for gastronomic purposes[AC0331].

Japan. The fresh bulb is used as a regular part of the diet[AC0163].

Kuwait. The bulb is taken orally as an emmenagogue and aphrodisiac[AC0176].

Malaysia. The bulb is taken orally for amenorrhea[AC0106].

Mexico. Decoction of the dried leaf, together with *Pimpinella anisum* and *Allium sativum*, is given orally to newborn infants[AC0280]. The root is taken orally to facilitate expulsion of the placenta[AC0138].

Nepal. The fresh bulb is taken orally for tuberculosis. Five hundred grams of the leaf of *Adhatoda vasica* is decocted in 5 liters of water until a dark brown mass remains. Half a teaspoonful of this drug is taken with honey and 10 grams *Allium cepa* twice daily for 6 months[AC0213].

Nigeria. The fresh bulb is taken orally as a carminative, tonic, antipyretic, hypotensive and diuretic[AC0264].

Peru. Hot water extract of the fresh bulb is taken orally to regulate blood pressure, dropsy, urinary problems, renal and biliary calculi, bronchitis and as an antidiabetic. Externally, the extract is used for acne[AC0317].

Philippines. Butanol extract of the dried bulb is taken orally to treat high blood pressure[AC0292].

Saudi Arabia. Hot water extract of the fresh bulb is taken orally for diabetes, dropsy, colic, catarrh, chronic bronchitis, scurvy, body heat, epilepsy, hysterical fits, nosebleed, jaundice, unclear vision, spleen enlargement, rheumatic pain and strangury[AC0205]. Hot water extract of the dried bulb is taken orally for diabetes, dropsy, colic, catarrh, chronic bronchitis, scurvy, epileptic fits, hysterical fits, epistasis, jaundice, enlarged spleen, rheumatic pain and strangury[AC0293].

Thailand. Fresh bulb essential oil, administered by inhalation, is used for the treatment of colds. The bulb is taken orally for gastrointestinal infections[AC0222].

Tunisia. The dried bulb is taken orally as an antiphlogistic, and is applied externally to treat infections[AC0279].

USA. The fresh bulb is taken orally as a sedative, blood purifier and expectorant[AC0374].

Vietnam. The bulb is taken orally as an emmenagogue[AC0107].

West Indies. Bulb juice with sugar is given to children for worms[AC0232].

Yemen. Hot water extract of the plant is used medicinally[AC0274].

Yugoslavia. Hot water extract of the fresh bulb is taken orally for diabetes[AC0242].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

(+)L-S-Prop-1-enyl-cysteine-s-oxide: Bu 25.8[AC0376]
1(F)-beta-fructosyl-sucrose: Bu[AC0359]
1-Methyl-dithio-propane: EO[AC0245]
1-Methyl-trithio-propane: EO[AC0245]
1-Propyl-dithio-propane: EO[AC0245]
1-Propyl-trithio-propane: EO[AC0245]
2-Methyl-but-2-en-1-al: Bu[AC0379]
2-Methyl-butyr-2-aldehyde: Bu[AC0370]
2-Methyl-penten-2-al: Headspace volatiles[AC0146]
2-Methyl-penten-2-en-1-al: EO[AC0245]
4-Alpha-methyl-zymostenol: Bu[AC0260]
4-S-Oxide(trans)dec-2-ene,5-ethyl-4,6,7-Trithia (diastereomer): Bu[AC0121]
4-S-Oxide(trans)dec-2-ene,5-ethyl-4,6,7-trithia: Bu[AC0121]
4-S-Oxide(trans/cis)deca-2,8-diene,5-ethyl-4,6,7-thithia (diastereomer): Bu[AC0121]
4-S-Oxide(trans/cis)deca-2,8-diene,5-ethyl-4,6,7-thithia: Bu[AC0121]

4-S-Oxide(trans/trans)deca-2,8-diene,5-ethyl-4,6,7-thithia (diastereomer): Bu[AC0121]
4-S-Oxide(trans/trans)deca-2,8-diene,5-ethyl-4,6,7-thithia: Bu[AC0121]
5-Dehydroavenasterol: Sd[AC0204]
6(G)-Beta-fructosyl-sucrose: Bu[AC0359]
2,3-Dimethyl-bicyclo(2,2,1)hexane-5-oxide-5,6-dithia(1,2,3,4-alpha-5-beta): Bu[AC0121]
2,3-Dimethyl-thiophene: Bu[AC0183]
2,4-Dimethyl-thiophene: Bu[AC0183], EO[AC0245]
24-Methylene cycloartanol: Bu[AC0260]
2,5-Dimethyl-thiophene: EO[AC0245]
28-Iso-fucosterol: Bu[AC0260]
31-Nor-cycloartenol: Bu[AC0260]
31-Nor-lanostenol: Bu[AC0260]
3,4-Dimethyl-2,5-dioxo-2,5-dihydrothiophene: EO[AC0245]
3,4-Dimethyl-thiophene: EO[AC0245]
9,10,13-Trihydroxy-octadec-11-enoic acid: Bu[AC0198]
9,12,13-Trihydroxy-octadec-10-enoic acid: Bu[AC0198]
Abscisic acid: Bu[AC0257]
Acetal: Bu[AC0379]
Acetic acid: Bu[AC0370]
Adenosine: Bu[AC0277,AC0208]
Allicin: Bu[AC0258,AC0208]
Alliin gamma-glutamyl peptide: Bu[AC0162]
Alliin: Bu[AC0182,AC0162]
Alliospiroside B: Fr 0.05%[AC0119]
Alliospiroside C: Fr 0.05%[AC0120]
Alliospiroside D: Fr 71.4[AC0120]
Allium cepa polysaccharide: Bu[AC0177]
Allyl-methyl-disulfide: Headspace volatiles[AC0146]
Allyl-propyl-disulfide: Bu[AC0146,AC0126]
Allyl-propyl-sulfide: Headspace volatiles[AC0146]
Allyl-propyl-trisulfide: Headspace volatiles[AC0146]
Alpha amyrin: Bu[AC0237]
Alpha linolenic acid: Bu[AC0189]
Alpha-sitosterol: Bu[AC0237]
Alpha-tocopherol: Sd oil[AC0185], Bu[AC0249]
Arabinose: Bu[AC0368]
Arachidic acid: Sd oil[AC0196]
Ascorbic acid: Bu[AC0181], Lf[AC0249]
Benzyl-iso-thiocyanate: Bu[AC0288]
Beta carotene: Bu 0.01[AC0145]
Beta-sitosterol: Bu[AC0260], Sd[AC0204]
Beta-tocopherol: Sd[AC0185]
Brassicasterol: Sd[AC0204]
Butane-cis-1-cis-4-dithial-S-S-dioxide,2,3-dimethyl: Bu[AC0370]
Caffeic acid: Bu[AC0373], Rt, Lf[AC0365]
Calcium oxalate: Bu[AC0112]
Campesterol: Sd[AC0204], Bu[AC0260]
Carotene: Fl 28[AC0384]
Catechol: Bu[AC0386]
Cepaene 1: Bu[AC0385,AC0329]
Cepaene 2-A: Bu[AC0385]
Cepaene 2-B: Bu[AC0385]
Cepaene 3: Bu[AC0385]
Cepaene 4-A: Bu[AC0385]
Cepaene 4-B: Bu[AC0385]
Cholest-7-en-3-beta-ol: Bu[AC0260]
Cholesterol: Sd[AC0204], Bu[AC0127,AC0260]
Choline: Bu 0.08%[AC0348]
Cis-1-(1-propenyl-dithio)-propane: EO[AC0245]
Cis-Propanethial-s-oxide: Bu[AC0224]
Cis-zweibelane: Bu[AC0160]
Citric acid: Bu, Lf[AC0367]
Cyanidin bioside: Bu[AC0382]
Cyanidin diglycoside: Bu[AC0382]
Cyanidin monoglycoside: Bu[AC0382]
Cyanidin-3-O-laminariobioside: Bu[AC0129]
Cyclo-(2,1,1)-heptane-5-oxide,cis-2,3-dimethyl-5,6-dithia: Bu[AC0197]
Cyclo-(2,1,1)-heptane-5-oxide,trans-2,3-dimethyl-5,6-dithia: Bu[AC0197]
Cycloalliin: Bu[AC0162]
Cycloartanol: Bu[AC0260]
Cycloartenol: Bu[AC0260]
Cycloeucalenol: Bu[AC0260]
Cysteine: Bu[AC0162]
Di-n-propyl-disulfide: Bu[AC0379]
Diallyl-disulfide: EO[AC0372]
Diallyl-sulfide: EO[AC0372]
Diallyl-trisulfide: EO[AC0372]
Dimethyl-disulfide: EO[AC0144], Headspace volatiles[AC0146]
Dimethyl-pentasulfide: EO[AC0144]
Dimethyl-sulfide: EO[AC0372]
Dimethyl-tetrasulfide: EO[AC0144]
Dimethyl-trisulfide: EO[AC0372,AC0144] Bu[AC0371]
Diphenylamine: Bu 0.004-1.1%[AC0184,AC0167]
Dipropyl-disulfide: Headspace volatiles[AC0146]
Dipropyl-tetrasulfide: EO[AC0144]
Dipropyl-trisulfide: EO[AC0144,AC0146]
DNA: Bu[AC0238]
Eicosen-1-ol: Sd oil[AC0185]

Ethanol: Bu[AC0370,AC0379]
Ferulic acid: Bu[AC0373], Rt, Lf[AC0365]
Fixed oil: Sd 17.3-18.1%[AC0185]
Fructose: Lf, Bu[AC0249]
Gamma-glutamyl leucine: Bu[AC0362]
Gamma-glutamyl-S-(Beta-carboxy-Beta-methyl-ethyl)-cysteinyl glycine, Bu[AC0360]
Gamma-L-glutamyl cysteine: Bu[AC0362]
Gamma-L-glutamyl-L-iso-leucine: Bu[AC0362]
Gamma-L-glutamyl-L-valine: Bu[AC0362]
Gamma-L-glutamyl-S-(2-carboxy-N-propyl)cysteine; Bu[AC0357]
Gamma-L-glutamyl-S-(2-carboxy-propyl)-L-cysteinyl glycine ethyl ester: Bu[AC0362]
Gamma-L-glutamyl-s-propenyl cysteine sulfoxide: Bu[AC0361]
Gibberellin A-4: Rt[AC0366]
Glucofructan (Allium cepa): Bu[AC0186]
Glucose: Lf, Bu[AC0249]
Glutamic acid: Bu[AC0165]
Glutathione: Bu[AC0162]
Glycine: Bu[AC0165]
Glycolic acid: Bu[AC0380]
Gramisterol: Bu[AC0260]
Hexadecen-1-ol: Sd oil[AC0185]
Iso-quercitrin: Bu[AC0187]
Iso-rhamnetin 4'-O-beta-D-glucoside: Bu[AC0174]
Iso-rhamnetin: Bu[AC0174]
Kaempferol: Skin[AC0346], Bu 2[AC0151]
Kaempferol-3,4'-di-O-beta-D-glucoside: Bu[AC0267]
Kaempferol-3-0-sophoroside-7-0-glucuronide: Epidermis[AC0122]
Kaempferol-4',7-di-O-beta-D-glucoside: Bu[AC0267]
Kaempferol-4'-0-beta-D-glucoside: Bu[AC0267,AC0190]
L-2-Propenyl-cysteine sulfoxide: Bu[AC0165]
L-Gamma-glutamyl-phenylalanine ethyl ester: Bu[AC0360]
L-Gamma-glutamyl-phenylalanine: Bu[AC0360]
Gamma-L-glytamyl-L-arginine: Bu[AC0357]
L-Methyl-cysteine sulfoxide: Bu[AC0165]
Linoleic acid: Sd oil 57.5-59.1%[AC0337,AC0185]
Lophenol: Bu[AC0260]
Lutein: Bu 0.02[AC0145]
Malic acid: Bu, Lf[AC0367]
Melatonin: Bu 31.5 pcg/gm[AC0163]
Methanol: Lf[AC0135], Bu[AC0370,AC0379]
Methionine methylsulfonium salt: Bu[AC0378]
Methionine sulfone: Bu[AC0378]
Methionine: Bu[AC0162]
Methyl,1-(methyl-sulfinyl)-propyl-disulfide: Bu[AC0191]
Methyl-dithio-methane: EO[AC0245]
Methyl-propyl-disulfide: EO[AC0144], Headspace volatiles[AC0146]
Methyl-propyl-tetrasulfide: EO[AC0144]
Methyl-propyl-trisulfide: EO[AC0144], Headspace volatiles[AC0146]
Mevalonic acid: Bu 0.5[AC0383]
Myristic acid: Sd oil[AC0196]
N-Propyl mercaptan: Bu[AC0133]
Nonadecanoic acid: Bu[AC0136]
Oleanolic acid: Bu[AC0237,AC0368]
Oleic acid: Sd oil 26-29%[AC0337,AC0185], Bu[AC0189]
Onion coat colorant: Bu[AC0149]
Oxalic acid: Bu, Lf[AC0268]
Palmitic acid: Sd oil 7.3%[AC0337], Bu[AC0189]
Para-coumaric acid: Bu, Lf, Rt[AC0365]
Para-hydroxybenzoic acid: Lf, Rt, Bu[AC0365]
Pelargonidin monoglycoside: Bu[AC0382]
Phloroglucinol carboxylic acid: Bu 100[AC0373]
Phloroglucinol: Bu 100[AC0373]
Prop-cis-enyl-disulfide: Bu[AC0183]
Prop(cis)enyl-propyl-disulfide: Headspace volatiles[AC0146]
Prop-(cis)-enyl-propyl-trisulfide: Headspace volatiles[AC0146]
Prop-(trans)-enyl-propyl-disulfide: Headspace volatiles[AC0146]
Prop-1-ene-1-thiol: Headspace volatiles[AC0146]
Prop-(trans)-enyl propyl-trisulfide: Bu[AC0146]
Propan-1-ol: Bu[AC0370]
Propane-1-thiol: Bu[AC0379]
Propanethiol: Headspace volatiles[AC0146]
Propional: Bu[AC0379]
Propionaldehyde: Lf[AC0135], Bu[AC0370]
Prostaglandin A: Bu[AC0243]
Prostaglandin A-1: Bu 1[AC0229]
Prostaglandin B: Bu[AC0243]
Prostaglandin E-1: Bu[AC0189]
Prostaglandin F: Bu[AC0243]
Protocatechuic acid: Lf[AC0365], Bu 0.45%[AC0373]
Pyrocatechol: Bu[AC0373]
Pyruvic acid: Bu[AC0225]
Quercetin: Bu 0.01-4.8%[AC0276,AC0353]
Quercetin-3,4'-di-O-Beta-D-glucoside: Bu[AC0233]
Quercetin-3-O-sophoroside-7-O-glucuronide: Epidermis[AC0122]

Quercetin-4',7-di-O-beta-D-glucoside: Bu[AC0267]
Quercetin-4-O-beta-D-glucoside: Bu[AC0125]
Raffinose: Bu, Lf[AC0249]
Rhamnose: Bu[AC0368]
Ribose: Bu[AC0368]
Rutin: Bu[AC0174]
S-(2-Carboxy-propyl) glutathione: Bu 125 mcg/gm[AC0201]
S-(beta-carboxy-beta-methyl-L-ethyl)cysteine: Bu[AC0360]
S-1-cis-propenyl ester methyl sulfinothioic acid: Bu[AC0197]
S-1-Cis-propenyl ester propyl sulfinothioic acid: Bu[AC0197]
S-1-Propenyl ester n-propyl sulphinothioic acid(cis): Bu[AC0121]
S-1-Propenyl ester n-propyl sulphinothioic acid(trans): Bu[AC0121]
S-1-Trans-propenyl ester methyl sulfinothioic acid: Bu[AC0197]
S-1-Trans-propenyl ester propyl sulfinothioic acid: Bu[AC0197]
S-Allyl-cysteine: Bu[AC0378]
S-Methyl-cysteine sulfoxide: Bu[AC0159]
S-N-Propyl ester N-propyl sulphinothioic acid: Bu[AC0121]
S-Propyl ester propyl sulfinothioic acid: Bu[AC0121]
S-Propyl-cysteine sulfoxide: Bu[AC0378]
Satiomem: Bu[AC0124]
Seleno methionine: Pl[AC0132]
Seleno homo-cystine: Pl[AC0132]
Seleno-methyl-seleno cysteine selenoside: Pl[AC0132]
Seleno-methyl-seleno cysteine: Pl[AC0132]
Seleno-methyl-seleno methionine: Pl[AC0132]
Sinapic acid: Lf, Bu, Rt[AC0365]
Sodium prop-(cis)-1-enyl-thiosulfate: Bu[AC0123]
Sodium prop-(trans)-1-enyl-thiosulfate: Bu[AC0123]
Sodium propyl-thiosulfate: Bu[AC0123]
Spiraeoside: Bu 1.13%[AC0353]
Stearic acid: Sd oil 3.5%[AC0353], Bu[AC0267]
Stigmast-7-en-3-beta-ol: Sd[AC0204]
Stigmasterol: Bu[AC0127], Sd oil[AC0185]
Succinic acid: Bu, Lf[AC0367]
Sucrose: Lf, Bu[AC0249]
Sugars: Bu[AC0225]
Thiopropanal-S-oxide: Bu[AC0369]
Thiopropional-S-oxide: Bu[AC0379]
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Trigonelline: Sd 13[AC0302]
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Tseposide B: Sd[AC0204]
Tseposide C: Sd[AC0204]
Tseposide D: Sd[AC0204]
Tseposide E: Sd[AC0204]
Tseposide F: Sd[AC0204]
Tuliposide A: Rt[AC0134]
Tuliposide B: Rt[AC0134]
Valine: Bu[AC0165]
Xylitol: Bu[AC0175]
Xylose: Bu[AC0368]
Zeaxanthin: Bu[AC0145]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient effect. Ethanol/water (1:1) extract of the seed, administered orally to female rats at a dose of 200.0 mg/kg, was inactive[AC0335].

Acid phosphatase inhibition. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the diet, was active. The study was conducted for 6 months in cholesterol-loaded animals[AC0251]. Water extract of the fresh bulb and the fresh bulb, administered intragastrically to rats, were active on RBC[AC0320].

Adenosine deaminase inhibition. Sap of the fresh bulb, at a concentration of 10.0 microliters, was inactive[AC0330].

Aflatoxin production inhibition. Water extract of the fresh bulb, at a concentration of 1.0 mcg/ml, was active on *Aspergillus flavus*. Aflatoxin B-1 production was inhibited 44.80%. On agar plate, a concentration of 250.0 mcg/ml was active. Aflatoxin B-1 production was inhibited 60.44%[AC0143].

Alanine racemase inhibition. Lyophilized extract of the fresh bulb, in the ration of chicken at a concentration of 2.0% of the diet, was active. Cu-Zn superoxide dismutase activity was inhibited[AC0141].

Alkaline phosphatase inhibition. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the

diet, was active. The study was conducted for 6 months in cholesterol-loaded animals[AC0251]. Water extract of the fresh bulb and the fresh bulb, administered intragastrically to rats, were active on RBC[AC0320].

Alkaline phosphatase stimulation. The fresh bulb, in the ration of rats at a concentration of 3.0% of the diet, was inactive[AC0150].

Allergenic activity. Acetone and water extracts of the bulb, applied by patch test to 3 subjects, were inactive. The ethanol (95%) extract was active[AC0230]. Aqueous slurry (homogenate) of the fresh bulb, applied externally to female adults, was active. Case reports of bronchial asthma, rhinoconjunctivitis and contact dermatitis were confirmed by skin tests[AC0158].

Alpha amylase inhibition. Water extract of the bulb was active[AC0226].

Analgesic activity. Ethanol (70%) extract of the fresh bulb, administered intraperitoneally to mice of both sexes at variable dosage levels, was active[AC0264].

Antifungal activity. The essential oil, on agar plate, was active on several plant pathogenic fungi[AC0111].

Antiallergenic activity. Ethanol (95%) extract of the fresh bulb was active on adults[AC0215]. Water extract of the fresh bulb, in cell culture at a concentration of 100.0 microliters/ml, was inactive on LEUK-RBL 3H3 vs biotinylated anti-DNP IgE/avidin-induced beta-hexosaminidase release[AC0166].

Antianaphylactic activity. Ethanol (95%) extract of the bulb, administered intraperitoneally to guinea pigs at a dose of 50.0 mg/kg, and orally at a dose of 100.0 mg/kg, was active vs egg albumin sensitization[AC0223].

Antiascariasis activity. Water extract of the bulb, at a concentration of 10.0 mg/ml, was active on earthworms[A05682].

Antiasthmatic activity. The bulb, taken orally by human adults at variable dosage levels, was active. The study involved 100 patients with bronchial asthma[AC0254]. Chloroform and ethanol (95%) extracts of the dried bulb were active in adults[AC0276]. Ethanol (95%) extract of the bulb, taken orally by 300 asthma patients of both sexes at a dose of 500.0 mg/person, was active[AC0223]. Ether extract of the fresh bulb, administered intragastrically to guinea pigs at a dose of 100.0 mg/kg, was active vs allergen-induced asthmatic reactions and platelet activating factor-induced asthmatic reactions, and inactive vs histamine-induced asthmatic reactions and acetylcholine-induced asthmatic reactions[AC0207]. Ethanol (95%) extract of the fresh bulb, administered by gastric intubation to guinea pigs at a dose of 1.0 ml/animal, was active vs allergen-induced bronchial asthma. Results significant at $p < 0.02$ level. The extract was inactive vs histamine- and acetylcholine-induced bronchial asthma. The water extract was inactive vs allergen-induced bronchial obstruction. Lipid fraction produced weak activity vs allergen-induced bronchial obstruction. Results significant at $p < 0.05$ level[AC0288].

Antiatherosclerotic activity. Butanol extract of the dried bulb, taken orally by human adults, was active. The treatment prevented the total rise in serum cholesterol, B-lipoprotein cholesterol, B-lipoprotein and serum triglycerides in patients with alimentary lipemia[AC0273].

Antibacterial activity. Infusion of the fresh bulb, in broth culture, was inactive on *Bacteroides melaninogenicus*, MIC 125.0 mg/ml; *Bifidobacterium longum*, MIC 15.6 mg/ml; *Clostridium paraputrificum*, MIC 15.6 mg/ml; *Bacteroides vulgaris*, MIC 31.2 mg/ml; *Eubacterium limosum*, MIC 31.2 mg/ml; *Fusobacterium nucleatum*, MIC 31.2 mg/ml; *Peptostreptococcus productus*, MIC 31.2 mg/ml; *Bacteroides fragilis*, MIC 62.5 mg/ml; *Clostridium perfringens*, MIC 62.5 mg/ml; *Eubacterium lentum*, MIC 62.5 mg/ml; *Serratia marcescens*, MIC >25.0 mcg/ml; *Acinetobacter calcoaceticus*, MIC >625.0 mcg/ml; *Citrobacter freundii*, MIC >625.0 mg/ml; *Pseudomonas aeruginosa*, MIC 625.0 mcg/ml

and *Streptococcus faecalis*, MIC 625.0 mg/ml. The infusion was active on *Staphylococcus aureus*, MIC 39.0 mcg/ml; *Staphylococcus aureus* 25923, MIC 3.9 mg/ml; *Propionibacterium acnes* MIC 7.8 mg/ml and *Propionibacterium intermedium*, MIC 7.8 mg/ml. The petroleum ether extract was active on *Clostridium paraputrificum*, MIC 20.0 mcg/ml and *Staphylococcus aureus* 25923, MIC 312.0 mcg/ml; inactive on *Propionibacterium intermedium*, MIC 625.0 mcg/ml and produced weak activity on *Bifidobacterium longum*, MIC 78.0 mcg/ml and *Propionibacterium acnes*, MIC 78.0 mg/ml[AC0195]. The fresh bulb juice, on agar plate, produced weak activity on *Staphylococcus aureus*[AC0351]. The fresh bulb, on agar plate, was inactive on *Escherichia coli* and *Staphylococcus aureus*, MIC 7.5 mg/ml. The chloroform extract was inactive on *Escherichia coli* and *Staphylococcus aureus*, MIC >6.0 mg/ml[AC0327]. Undiluted juice of the fresh bulb, on agar plate, was active on *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Salmonella typhosa*[AC0363]. Tincture of the dried bulb (10 gm of plant material in 100 ml ethanol), on agar plate at a concentration of 30.0 microliters/disc, was inactive on *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*[AC0318]. Water extract of the bulb, on agar plate at a concentration of 1:16, was active on *Escherichia coli* and *Serratia marcescens*, and inactive on *Pseudomonas aeruginosa*. A concentration of 1:256 was active on *Streptococcus sanguis*; 1:32 was active on *Lactobacillus odontolyticus* and inactive on *Serratia marcescens*; 1:64 was active on *Streptococcus milleri*. Undiluted concentration produced weak activity on *Bacillus cereus*, *Entobacter cloacae* and *Streptococcus hominis*[AC0266]. Water extract of the bulb, on agar plate, was active on *Escherichia coli* and *Streptococcus faecalis*[AC0387]. Water extract of the dried bulb, on agar plate, was active on *Bacillus mycoides*, *Escherichia coli*, *Klebsiella pneumonia* and *Staphylococcus aureus*. The extract was inactive on *Proteus vulgaris*[AC0220]. Water extract of the fresh bulb was inactive on *Escherichia coli* and *Micrococcus luteus* [AC0172].

Anticholesterolemic activity. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the diet, was inactive. The study was conducted for 6 months in cholesterol-loaded animals[AC0251]. The fresh bulb, administered orally to rabbits, was active. Hypercholesterolemic rabbits that were fed a cholesterol and onion extract diet had a lower level of total lipids, cholesterol and phospholipids in the eyes than those fed only cholesterol. This level was similar to the control group[AC0269].

Anticlastogenic activity. Bulb juice, administered intragastrically to mice at a dose of 25.0 ml/kg, was active on bone marrow cells vs mitomycin C-, dimethylnitrosamine-, and tetracycline-induced micronuclei[AC0157].

Anticoagulant activity. Butanol extract of the fresh bulb, taken orally by adults at a dose of 200.0 gm/person, was active. The subjects consumed a high fat meal prior to testing[AC0296].

Anticonvulsant activity. Ethanol (70%) extract of the fresh bulb, administered intraperitoneally to mice of both sexes at variable dosage levels, was active vs metrazole- and strychnine-induced convulsions[AC0264].

Anticrustacean activity. Ethanol (95%) extract of the dried bulb was inactive on *Artemia salina*. The assay system was intended to predict for antitumor activity[AC0142].

Antiedema activity. Methanol extract of the bulb, applied on the ears of mice at a dose of 2.0 mg/ear, was active vs 12-0-tetradecanoylphorbol-13-acetate (TPA)-induced ear inflammation. Inhibition ratio (IR) was 15[AC0148].

Antifertility effect. Hot water extract of the dried bulb scales, at a concentration of 20% in the drinking water, and administered intraperitoneally at variable dosage levels, was equivocal in pregnant mice[AC0311].

Antifilarial activity. The fresh bulb was active on *Setaria digitata*, LC_{100} 7000 ppm[AC0320].

Antifungal activity. Water extract of the fresh leaf, on agar plate, produced weak activity on *Ustilago maydis*[AC0282]. Acetone extract of the dried entire plant inhibited spore germination of *Helminthosporium turcicum*[AC0179]. Bulb essential oil, at a concentration of 10.0%/disc on agar plate, was active on *Geotrichum candidum*[AC0275]. Essential oil of the bulb, on agar plate at variable concentrations, was active on *Cladosporium werneckii*[AC0259]. Ethanol/water (1:1) extract of the bulb, on agar plate at a concentration of 1042 mg/ml (expressed as dry weight of plant), was active on *Aspergillus niger*, and inactive on *Aspergillus fumigatus*, *Botrytis cinerea*, *Penicillium digitatum*, *Rhizopus nigricans* and *Trichophyton mentagrophytes*[AC0324]. A concentration of 500 mg/ml was active on *Fusarium oxyporum*, and inactive on *Aspergillus fumigatus*, *Aspergillus niger*, *Botrytis cinerea*, *Penicillium digitatum*, *Rhizopus nigricans* and *Trichophyton mentagrophytes*[AC0305]. Ethanol/water (50%) extract of the dried leaf was active on *Rhizoctonia solani*. Mycelial inhibition was 52.90%[AC0326]. The fresh bulb, on agar plate, was active on *Nannizzia fulva*, *Nannizzia gypsea* and *Nannizzia incurvata*[AC0388]. Water extract of the bulb, at a concentration of 250.0 mcg/ml on agar plate, was active on *Aspergillus flavus*; growth was inhibited 52.35%[AC0143]. The fresh bulb, on agar plate, was inactive on *Trichophyton andouinii*, *Trichophyton rubrum*, *Trichophyton schoenleini* and *Trichophyton tonsurans*, MIC 1000 mcg/ml; *Aspergillus fumigatus*, MIC 2000 mcg/ml; *Microsporum canis*, MIC 500 mcg/ml and *Trichophyton mentagrophytes*, MIC >1000 mcg/ml[AC0327].

Antihistamine activity. Ethanol (95%) extract of the bulb, administered orally to guinea pigs at a dose of 200.0 mg/kg, and intraperitoneally at a dose of 50.0 mg/kg, was active vs histamine aerosol[AC0223].

Antihypercholesterolemic activity. The bulb juice, administered orally to rabbits, was active. The animals were fed a high cholesterol diet, and the juice of 25 gm of onion/kg of body weight daily for 16 weeks[AC0234]. The bulb, taken orally by human adults at a dose of 100.0 gm/person, was active. Statistical data indicate significant results[AC0389]. Butanol extract of the fresh bulb, taken orally by male human adults at a dose of 50.0 gm/person, was inactive. The study utilized 10 healthy subjects ranging in age from 18 to 30 years. The subjects were given a fatty breakfast containing 100 gm butterfat. The breakfast produced a significant increase in serum cholesterol and plasma fibrinogen, and a decrease in blood fibrinolytic A. After the administration of either raw or boiled onion, no significant change in serum cholesterol or plasma fibrinogen levels was seen. Statistical data indicate significant results[AC0235]. Ethanol (95%) extract of the fresh bulb, administered by gastric intubation to rabbits at a dose of 20.0 gm/animal, was inactive. Cholesterol-loaded diet was used daily for 3 months. The onion extract appeared to prevent crenation and aggregation of RBC[AC0250]. The essential oil, administered by gastric intubation to rats at a dose of 100.0 mg/kg for 60 days, was active vs ethanol-induced hyperlipemia. Results significant at $p < 0.01$ level[AC0290]. The fixed oil, in the ration of male rats at a dose of 100.0 mg/kg, was active. Simultaneous feeding of unsaturated oil from the plant material with a high sucrose diet significantly reduced serum and tissue cholesterol levels, and a small but significant tissue-protein reducing effect was also observed[AC0256]. The outer skin fiber, in the ration of male rats at a dose of 263.0 gm/day, was active[AC0164]. Scales of bulb, administered by gastric intubation to rats at a dose of 5.0 mg/kg for 45 days, was active[AC0354].

Antihyperglycemic activity. The bulb, taken orally by human adults at variable dosage levels, was active. Addition of raw onion to the diet lowered the amount of

anti-diabetic drugs needed to control the disease in diabetic patients[AC0300]. Decoction of the fresh bulb, administered intragastrically to mice at a dose of 0.5 ml/animal, was active. Twenty-five percent aqueous extract was used and produced a maximal change in blood sugar of 28.2% vs alloxan-induced hyperglycemia[AC0205]. Ethanol (95%) extract of the bulb, administered by gastric intubation to rabbits, was active. The petroleum ether extract produced strong activity vs epinephrine- and alloxan-induced hyperglycemia[AC0249]. Ethanol (95%) extract of the bulb, at a dose of 250.0 mg/kg, was active in rabbits vs alloxan-induced hyperglycemia. A 18.57% drop in blood glucose was observed at 2 hours post-treatment[AC0130]. Ether and ethanol (95%) extracts of dried bulb, var. Behairy, administered by gastric intubation to rats at a dose of 50.0 gm/kg (expressed as dry weight of the bulb), were active vs alloxan- and epinephrine-induced hyperglycemia[AC0291]. Ether extract of the aerial part, administered subcutaneously to rats at a dose of 0.5 ml/animal daily for 10 days, was equivocal vs alloxan-induced hyperglycemia. The plant juice produced weak activity[AC0333]. Ether extract of the fresh bulb, administered intragastrically to rabbits at doses of 100 mg/animal/day for 7 days[AC0203], and 250 mg/kg[AC0116], was active vs alloxan-induced hyperglycemia. Water extract of the fresh bulb, taken orally by human adults at a dose of 100.0 gm/person, was active vs glucose- and adrenalin-induced hyperglycemia[AC0117]. Fresh bulb juice, administered intragastrically to rabbits at a dose of 25.0 gm/animal (expressed as dry weight of plant), was active vs glucose-induced hyperglycemia[AC0115]. Fresh bulb juice, taken orally by human adults at a dose of 50 gm/person, was active in diabetic patients[AC0203]. Petroleum ether extract of the fresh bulb, administered intragastrically to rabbits at a dose of 250 mg/kg, was active vs alloxan-induced hyperglycemia[AC0114]. Hot water extract of the dried bulb, administered by gastric intubation to mice at a dose of 0.5 ml (25% of the extract), was active vs alloxan-induced hyperglycemia[AC0293]. Plant juice, taken orally by human adults at a dose of 50.0 gm/person, was active. Blood sugar level was reduced 30-50 mg percent. When administered orally to rabbits at a dose of 10.0 ml/animal, a 13.4 mg percent drop in blood sugar level was observed after 8 days of treatment[AC0131]. Water extract of the dried bulb, administered intravenously to mice at a dose of 70.0 mg/kg, was active vs alloxan-induced hyperglycemia[AC0301].

Antihyperlipemic activity. The bulb, taken orally by human adults at a dose of 100.0 gm/person, was active[AC0389]. The water extract, administered orally to rabbits at a dose of 10.0 ml/kg, was active. Hyperlipidemia was induced by long term feeding of sucrose. There was a significant reduction in serum, liver and aorta triglycerides, and serum and liver proteins, and a significant increase in liver free amino acids[AC0228]. The essential oil, administered by gastric intubation to rats at a dose of 100.0 mg/kg for 60 days, was active. The effect was measured in the liver vs ethanol-induced hyperlipemia. Results significant at $p < 0.01$ level[AC0290]. The essential oil, taken by male adults, was active[AC0306]. Saponin fraction of the bulb, taken orally by adults at a dose of 50.0 gm/person, was active[AC0321]. The fixed oil, in the ration of male rats at a dose of 100.0 mg/kg, was active. Simultaneous feeding of unsaturated oil from the plant material with a high sucrose diet significantly reduced serum and tissue cholesterol levels, and a small but significant tissue-protein reducing effect was observed[AC0256]. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the diet, was inactive. The study was conducted for 6 months in cholesterol-loaded animals[AC0251].

Antihypertensive activity. Ethanol (95%) extract of the fresh bulb, in the ration of

rats, was inactive. The extraction was made at zero degrees Celsius. Four ml of the extract was fed for 3 weeks, then salt was added and the dose increased to 8 ml. Salt did not affect blood pressure in the spontaneously hypertensive animals[AC0199].

Antihypertriglyceridemic effect. Outer skin fiber, in the ration of male rats at a dose of 263.0 gm/day, was active[AC0164].

Anti-implantation effect. Ethanol (95%) extract of the bulb, administered orally to rats, was inactive[AC0219]. Water extract of the dried seed, administered intraperitoneally to female rats, was inactive[AC0309].

Anti-inflammatory activity. The bulb, taken orally by adults at variable dosage levels, was active[AC0261]. Ethanol (80%) extract of the bulb, administered by gastric intubation to male rats at a dose of 100.0 mg/kg, was inactive vs carrageenin-induced pedal edema[AC0193].

Antimutagenic activity. Water extract of the fresh bulb, at a dose of 0.4 ml/plate, was active on *Salmonella typhimurium* TA100, vs TRP-P-2 mutagenicity with S9 mix[AC0310].

Antimycobacterial activity. Ethanol (95%) extract of the bulb, on agar plate, was inactive on *Mycobacterium tuberculosis*[AC0332]. Ethanol (95%) extract of the fresh seed, on agar plate, produced strong activity on *Mycobacterium tuberculosis*. The extract was prepared using 1 part of fresh plant to 3 parts of solvent[AC0334].

Antioxidant activity. The fresh bulb, at a concentration of 1.0%, was inactive. The effect was seen at 120 degrees Fahrenheit[AC0390]. The fresh bulb homogenate produced 24% inhibition of lipid peroxidation, results significant at $p < 0.05$ level[AC0169]. Hot water extract of the bulb was active[AC0336]. Hot water extract of the fresh aerial part produced strong activity[AC0336].

Antiradiation effect. The dried bulb, in the ration of rats at a concentration of 20.0 mg/kg, was active vs X-irradiation[AC0355].

Antisickling activity. Water extract of the fresh bulb, in cell culture at a concentration of 40.0 microliters, was active on platelets vs epinephrine-induced aggregation[AC0209].

Antispasmodic activity. Ethanol (95%) extract of the bulb, at a concentration of 4.0 mg/ml, was active on the guinea pig ileum vs $BaCl_2$, 5-HT, acetylcholine, and histamine spasms[AC0223].

Antispermatogenic effect. Essential oil of the bulb, administered by inhalation to male rats, was inactive[AC0339].

Antithiamine activity. The fresh bulb juice was active. The activity was heat stable[AC0281].

Antithyroid activity. Butanol extract of the fresh bulb, taken orally by adults at a dose of 93.0 gm/person, was inactive. Iodine uptake by the thyroid was measured[AC0375].

Antitoxic activity. Essential oil, administered by gastric intubation to rats at a dose of 100.0 mg/kg, was active. The treatment prevented ethanol-induced serum cholesterol and triglyceride rise, kidney and liver cholesterol accumulation, hepatic total lipid rise, and serum albumin reduction vs ethanol-induced hyperlipemia[AC0285].

Antitumor activity. Ethanol (95%) extract of the bulb, administered intraperitoneally to rats at a dose of 50.0 mg/kg, produced weak activity on Sarcoma III(MTK)[AC0108]. The fresh bulb, taken orally by adults at variable dosage levels, was active. Interviews conducted with 564 patients with stomach cancer and 1131 controls revealed a significant reduction in gastric cancer risk with increasing consumption of *Allium cepa*[AC0194]. Essential oil, applied externally on female mice at a dose of 1.0 mg/animal vs twice weekly 12-0-tetradecanoyl-phorbol-13-acetate promotion for 2 weeks, followed by mezerein promotion for 18 weeks, was active. The dose, when given with a second promoter, produced a 32% decrease in incidence of papilloma vs DMBA-induced carcinogenesis[AC0211]. Hot water extract of the fresh bulb, applied externally on mice at a dose of 1.0 mg/animal, was active vs DMBA-induced carcinogenesis[AC0323]. Hot water ex-

tract of the fresh bulb, in cell culture, produced weak activity on RAJI cells vs phorbol myristate acetate-promoted expression of EB virus early antigen[AC0147].

Antiviral activity (plant pathogens). Water extract of the leaf produced strong activity on Tobacco Mosaic virus[AC0110]. Aqueous low-speed supernatant, at a concentration of 1.0%, and the undiluted juice of the fresh bulb, were active on top necrosis virus[AC0180].

Antiviral activity. Ethanol (80%) extract of freeze-dried entire plant, at variable concentrations in cell culture, was equivocal on Poliovirus 1, and inactive on Adenovirus (unspecified), Coxsackie B2 virus, Herpes virus type 1, Measles virus and Semlicki-forest virus vs plaque-inhibition[AC0262].

Antiyeast activity. Bulb essential oil, at a concentration of 1.0%/disc, was active on *Brettanomyces anomalus*, *Hansenula anomala*, *Kloeckera apiculata* and *Lodderomyces elongisporus*. A concentration of 10.0%/disc was active on *Kluyveromyces fragilis*, *Metschnikowia pulcherrima*, *Pichia membranaefaciens*, *Rhodotorula rubra*, and *Saccharomyces cerevisiae*, and inactive on *Candida lipolytica*[AC0275]. Dried oleoresin, on agar plate at a concentration of 500.0 ppm, was active on *Bebaryomyces hansenii* vs ascospore production, and on *Rhodotorula rubra* vs pseudomycelium production. The oleoresin was inactive on *Candida albicans*, *Saccharomyces cerevisiae*, *Torulopsis glabrata*, and *Hansenula anomala* vs pseudomycelium production, and on *Hansenula anomala*, *Saccharomyces cerevisiae* and *Lodderomyces elongisporus* vs ascospore production. Weak activity was produced on *Lodderomyces elongisporus* vs pseudomycelium production. A concentration of 500.0 ppm, in broth culture, was active on *Debaryomyces hansenii*, *Hansenula anomala* and *Saccharomyces cerevisiae* vs biomass production, and inactive on *Candida lipolytica*, *Kloeckera apiculata*, *Lodderomyces elongisporus*, *Rhodotorula rubra* and *Torulopsis glabrata* vs biomass production[AC0313]. Ethanol/water (1:1) extract of the bulb, at concentrations of 500 mg/ml[AC0305] and 1042 mg/ml[AC0324] (dry weight of the plant material) on agar plate, were inactive on *Candida albicans* and *Saccharomyces pastorianus*. The fresh bulb, on agar plate, was inactive on *Candida stellatoidea*, MIC 1000 mcg/ml and *Candida albicans*, MIC 470.0 mcg/ml. The chloroform extract was inactive on *Candida albicans*, MIC >6.0 mg/ml[AC0327]. Tincture of the dried bulb (10 gm of plant material in 100 ml ethanol), on agar plate at a concentration of 30.0 microliters/disc, was inactive on *Candida albicans*[AC0318]. Water extract of the bulb, on agar plate, produced weak activity on *Candida albicans* and *Saccharomyces cerevisiae*[AC0266].

Appetite stimulant. The bulb, taken orally by adults, was active. It is claimed to be a tonic medicine and capable of accelerating recovery from fatigue. When mixed with equal weight of starch, it is free of unpleasant odor and taste. The biological activity has been patented[AC0231].

Ascorbic acid lowering effect. The fresh bulb, in the ration of rats at a concentration of 3.0% of the diet, was active[AC0150].

ATPase (mg^{++}) inhibition. The bulb, administered intragastrically to rats, was active, and the water extract was inactive on RBC[AC0320].

ATPase inhibition. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the diet, was active. The study was conducted for 6 months in cholesterol-loaded animals[AC0251].

Blood pressure effect (biphasic). Water extract of the dried bulb, administered intravenously to cats and rats at a dose of 0.1 mg/kg, was active. A concoction of *Nicotiana tabacum* leaf, *Ocimum basilicum* leaf, *Allium sativum* leaf, *Allium cepa* bulb, *Allium ascabricum* bulb, *Citrus limon* fruit juice, cow's urine, and trona (an alkaloid mineral substance) was used. The treatment pro-

duced an initial hypotensive effect followed by hypertension[AC0283].

Bradycardia activity. Water extract of the dried bulb, administered intravenously to cats and rats at a dose of 10–20 mg/kg, produced weak activity[AC0283].

Bronchodilator activity (autonomic). Chloroform extract of the fresh bulb, administered intragastrically to guinea pigs at a dose of 20.0 mg/kg, was active vs allergen-induced bronchial obstruction. A dose of 80.0 mg/kg was active vs PAF-induced bronchial obstruction. Ether extract, at a dose of 20.0 mg/kg, and lyophilized extract, at a dose of 100.0 mg/kg, were active vs allergen-induced bronchial obstruction [AC0197]. Ethanol (95%) extract of the fresh bulb, administered by inhalation to human adults, was active vs allergen- and platelet aggregating factor-induced bronchial obstruction[AC0215].

Bronchodilator activity. Chloroform and ethanol (95%) extracts of the bulb were active; benzene, methanol and petroleum ether extracts were inactive[AC0276].

Carcinogenesis inhibition. Essential oil, applied externally to mice at a concentration of 0.01 mg/animal, was active vs phorbol myristate acetate-induced carcinogenesis of the skin[AC0286]. A dose of 2.0 mg/animal, applied 30 minutes before DMBA, resulted in 50% decrease in incidence of carcinoma vs DMBA-induced carcinogenesis[AC0211].

Cardiac activity. Ethanol (95%) extract of the bulb, administered by perfusion to the heart of the guinea pig at a dose of 10.0 mg, was inactive[AC0223].

Cardiovascular effect. Water extract of the dried bulb, administered intravenously to cats and rats at a dose of 10-20 mg/kg, produced no change in ECG[AC0283].

Choleretic activity. Butanol extract of the bulb, in the ration of dogs, was active[AC0341]. The fresh bulb juice was active on rats[AC0340].

Cholesterol inhibition. The entire plant, together with cholesterol in the ration of rabbits, was inactive[AC0137].

Cholesterol level decrease. The fresh bulb, in the ration of rats at a concentration of 3.0% of the diet, was active[AC0150].

Chronotropic effect (positive). Ethanol/water (1:1) extract of the fresh bulb, administered by gastric intubation to rats at a dose of 40.0 ml/kg, was inactive[AC0295].

CNS depressant activity. Butanol extract of the bulb, in the ration of dogs, was active[AC0341].

Coagulant activity. Essential oil, administered by gastric intubation to male rabbits at a dose of 2.0 gm/kg for 3 months, produced strong activity. There was an increase in coagulation time. Results significant at $p < 0.001$ level[AC0278].

Cyclooxygenase inhibition. Essential oil of the dried entire plant, at a concentration of 0.35 mg/ml, was active on rabbit platelets[AC0315]. Chloroform extract of the bulb, at variable dosage levels, was active on the platelets[AC0240]. The freeze-dried bulb juice, at variable concentrations, was active. This was a review on the anti-asthmatic activity of onion, including the identification of several sulfur compounds found in onion and their effects on cyclooxygenases[AC0329]. Methanol extract of the fresh bulb, at a concentration of 100.0 mcg/ml, was active. Ether soluble material produced 46% inhibition. The ether insoluble material was inactive with 4% inhibition[AC0152].

Cytotoxic activity. The dried bulb, in cell culture at a concentration of 25.0%, was active on Hamster-CA-HCPC-1[AC0314]. Water extract of the fresh leaf, on agar plate, was inactive on *Ustilago nuda*[AC0282].

Desmutagenic activity. Aqueous high speed supernatant of the fresh unripe fruit juice, on agar plate at a concentration of 0.5 ml/plate, was inactive on *Salmonella*

typhimurium TA98 vs mutagenicity of L-tryptophan pyrolysis products. The assay was done in the presence of S9 mix[AC0303]. The fresh plant juice, on agar plate at a concentration of 0.5 ml/plate, was inactive on *Salmonella typhimurium* TA98[AC0304].

Diuretic activity. Butanol extract of the bulb, in the ration of dogs, was active[AC0341]. Ethanol/water (1:1) extract of the fresh bulb (5 parts of fresh bulb in 100 parts ethanol/water), administered intragastrically to rats at a dose of 40.0 ml/kg, was active[AC0192]. The fresh bulb juice, administered by gastric intubation to rabbits, was active[AC0340]. Methanol extract of scales of the bulb, administered to dogs, was active[AC0353].

DNA synthesis inhibition. Essential oil, applied externally to female mice at a dose of 5.0 mg/animal, produced 86% inhibition when the oil was applied 2 hours before DMBA vs DMBA-induced carcinogenesis[AC0211].

Embryotoxic effect. Ethanol/water (1:1) extract of the seed, administered orally to female rats at a dose of 200.0 mg/kg, was inactive[AC0335].

Fibrinolytic activity. Butanol extract of the bulb, taken orally by human adults, was active. The bulb juice, in the ration of rabbits, was active[AC0273]. Butanol extract of the fresh bulb, taken orally by adults, was active[AC0239]. The essential oil, administered by gastric intubation to male rabbits at a dose of 2.0 gm/kg for 3 months, decreased fibrinolytic activity. Results significant at $p < 0.001$ level[AC0278].

Gastric inhibitory polypeptide stimulation. The bulb, in the ration of rabbits and rats, produced weak activity vs cholesterol-loaded animals[AC0255].

Glucose uptake induction. Ether extract of the fresh bulb, administered intragastrically to rabbits at a dose of 250 mg/kg, was active vs alloxan-induced hyperglycemia[AC0116].

Glutamate pyruvate transaminase inhibition. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the diet, was active. The study was conducted for 6 months on cholesterol-loaded animals[AC0251].

Glutathione peroxidase inhibition. Lyophilized extract of the fresh bulb, in the ration of chicken at a concentration of 2.0% of the diet, was inactive[AC0141].

Goitrogenic activity. The bulb, in the ration of rats at a concentration of 20.0% of the diet for 4 weeks, was active[AC0356].

Growth promoter activity. Benzene/chloroform (6:4) extract of the fresh fruit essential oil, diluted to the same concentration as in fresh onion juice and administered intragastrically to rats at a dose of 5.0 ml/kg for 42 days, was inactive. Body weight, growth, and organ weights were unaffected. Protein content of the kidneys was greater than that of controls. Polyamine content of the organs was not different from the controls. Undiluted essential oil of the fresh onion, administered intragastrically to rats at a dose of 5.0 ml/kg for 42 days, was active. Body weight, growth, and weight of the spleen, muscles, heart and protein content of major organs were greater than vehicle-treated controls. Polyamine contents of the liver and kidney were higher than the controls. Ether extract of fresh onion juice, diluted to the same concentration as fresh onion juice and administered intragastrically to rats at a dose of 5.0 ml/kg for 42 days, was active. Body weight, growth, and weights of muscle, heart, lungs, and protein content of organs were greater than vehicle-treated controls. Polyamine contents of the liver and kidneys were higher than the controls. Methanol extract of fresh onion juice, diluted to the same concentration as fresh onion juice and administered intragastrically to rats at a dose of 5.0 ml/kg for 42 days, was active. Body weight and the weight of the heart and lungs were greater than the vehicle-treated controls. Polyamine content of the liver was greater

than the controls, but the organ protein content was unaffected[AC0319].

Hemotoxic activity. The bulb, in the ration of guinea pigs at variable concentrations, was active. The bulb was fed in raw form, cooked or as various types of extracts. The result was a decrease in red blood cell count; the decrease was proportional to the amount fed. Changes in the white blood cell count were variable. Death occurred within 23 days after starting the animals on a diet containing high doses. The red blood cell count decreased from 5 million to 3.5 million[AC0343]. Ethanol (95%) extract of the dried bulb, administered intraperitoneally to guinea pigs, was active. Anemia was induced. The water and ether extracts were inactive[AC0352]. The fresh bulb, administered by gastric intubation to dogs at a dose of 15.0 gm/kg, was active. Daily dosing for 6 days produced anemia characterized by a red blood cell count of 1.99 million (7.76 million prior to onion dosing), hemoglobin concentration of 30 (91 prior to dosing) and a white blood cell count of 25,000 (10,900 prior to dosing). Data was comparable following dosing with autoclaved onions and/or autoclaved onion juice[AC0347]. Butanol extract of the fresh bulb, in the ration of cattle at a concentration of 25.0% of the diet, was active. A decrease in the number of red blood cells and hemoglobin concentration was observed[AC0323].

Histamine release inhibition. Ethanol (75%) extract of the fixed oil, in cell culture, was active on the human basophil. The biological activity has been patented[AC0168].

Hydroxy(17)-steroid urinary excretion increased. The fresh bulb, in the ration of rats at a concentration of 2.0% of the diet, was active[AC0150].

Hypercholesterolemic activity. The bulb, taken orally by adults, was active. Cholesterol levels were elevated in subjects on moderate or heavy amounts of onion, 50–100 gm, and garlic, 5–10 gm[AC0156]. The dried bulb, administered orally to male rats at a dose of 5.0 gm/kg daily for 56 days, was active[AC0227]. Water extract of the fresh bulb, administered intragastrically to rats, was active[AC0320].

Hyperglycemic activity. The fresh bulb and ether extract of the fresh bulb, administered to pancreatectomized dogs by gastric intubation, were active[AC0349]. Methanol extract of the dried bulb, administered intragastrically to rats at a dose of 2.0 gm/kg, was inactive[AC0153].

Hyperlipidemic activity. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the diet, was active. The study was conducted for 6 months on cholesterol-loaded animals[AC0251].

Hypertensive activity. Ethanol (95%) extract of the bulb, administered intravenously to dogs at a dose of 100.0 mg/kg, was inactive[AC0223].

Hypocholesterolemic activity. The fresh bulb, administered intragastrically to rats, was active[AC0320]. The butanol extract, taken orally by male adults at a dose of 50.0 gm/person, was inactive. The study used 10 healthy subjects; no effect on serum cholesterol, fibrinogen or fibrinolytic activity in normal fasting subjects was observed. Statistical data indicate significant results[AC0236]. Water extract of the fresh bulb, taken orally by adults at a dose of 50.0 gm/person, was inactive. The extract was given to people with normal blood serum cholesterol levels[AC0272]. Lyophilized extract of the fresh bulb, in the ration of chicken at a concentration of 2.0% of the diet, was inactive[AC0141]. The raw onion, taken orally by normal adults at a dose of 80.0 gm/person daily for 5 months, was active[AC0178].

Hypoglycemic activity. Chloroform extract of the raw bulb, administered by gastric intubation to rabbits, produced strong activity vs glucose-induced hyperglycemia. The treatment was 79.4% as effective as tolbutamide. The petroleum ether extract

was active[AC0271]. Chloroform, ethanol (95%), and petroleum ether extracts of the fresh bulb, administered by gastric intubation to rabbits, were active[AC0184]. Ethanol (95%) extract of the bulb, administered by gastric intubation to rabbits, was active. The petroleum ether extract produced strong activity[AC0249]. Ether and petroleum ether extracts of the bulb, administered by gastric intubation to male rabbits at a dose of 0.25 gm/kg, were active[AC0345]. Ether extract of the fresh bulb, administered to pancreatectomized dogs and rabbits by gastric intubation, was active[AC0349]. Ether extract of the fresh bulb, administered intragastrically to rabbits at a dose of 250 gm/kg, was active[AC0116]. The water extract, taken orally by adults at a dose of 200.0 gm/person, was inactive[AC0118]. A dose of 10.0 mg/kg, administered orally to rabbits, was active. A drop in blood sugar of 15 mg relative to inert-treated controls indicated positive results[AC0118]. The fresh bulb juice, administered intravenously to rabbits, was active[AC0340]. Methanol extract of the dried bulb, administered intragastrically to rats at a dose of 2.0 gm/kg, was inactive[AC0153]. Petroleum ether and petroleum ether-insoluble extracts of the dried bulb, administered by gastric intubation to female rats at a dose of 0.25 gm/kg, were inactive[AC0221]. The plant juice, administered subcutaneously to rats at a dose of 0.5 ml/animal daily for 10 days, was inactive. Fasting blood sugar levels were determined[AC0333].

Hypolipemic activity. The essential oil, administered by gastric intubation to rats at a dose of 100.0 mg/kg for 60 days, was active. The effect was measured in the liver. Results significant at $p < 0.01$ level vs ethanol-induced hyperlipemia[AC0285]. The fresh bulb and water extract of the fresh bulb, administered intragastrically to rats, were active on RBC[AC0320]. The bulb juice, in the ration of rabbits, was active. The treatment prevented a rise in the levels of serum cholesterol for up to 60 days[AC0273].

Hypotensive activity. Chloroform extract of the fresh bulb, administered intravenously to rats at a dose of 1.0 mg/animal, was active[AC0241]. Ethanol (70%) extract of the fresh bulb, administered intravenously to rats at variable dosage levels, was active[AC0264]. Ethanol (95%) extract of the bulb, administered intravenously to dogs at a dose of 100.0 mg/kg, was inactive[AC0223]. Ethanol/water (1:1) extract of the fresh bulb sap, administered by gastric intubation to rats at a dose of 40.0 ml/kg, produced weak activity[AC0295]. Water extract of the dried bulb, administered intravenously to cats and rats at doses of 5 to 20 mg/kg, produced weak activity[AC0283].

Hypotriglyceridemia activity. Lyophilized extract of the fresh bulb, in the ration of chicken at a concentration of 2.0% of the diet, was inactive[AC0141].

Immunosuppressant activity. Aqueous suspension of the fresh bulb, administered by gastric intubation to rabbits at a concentration of 10.0%, was active[AC0270].

Insect attractant activity. Butanol extract of the fresh bulb was active on *Delia antiqua*[AC0188].

Lacrymation stimulation. Juices of the bulb of red globe, white globe, and madras varieties were active when applied ophthalmically to human adults[AC0128].

Lactate dehydrogenase stimulation. Water extract of the fresh bulb, in the ration of rabbits at a concentration of 20.0% of the diet, was active. The study was conducted for 6 months in cholesterol-loaded animals[AC0251].

Lipid metabolism effects. Ethanol (100%) extract of the bulb was active in rats[AC0307]. Ethanol (95%) extract of the fresh bulb, in the ration of rats, was active. The extraction was made at zero degrees Celsius. Four ml of the extract was fed for 3 weeks, then salt was added and the dose increased to 8 ml. Salt did not affect blood pressure in the spontaneously hypertensive animals. Arachidonic acid level was decreased[AC0199].

Lipid peroxide formation inhibition. Hot water extract of the fresh bulb was active vs T-butyl hydroperoxide/heme-induced luminol-enhanced chemiluminescence[AC0147].

Lipoxygenase inhibition. The essential oil, at variable concentrations, was active[AC0202]. Ethanol (75%) extract of the fixed oil was active on the polymorphonuclear leukocytes of guinea pigs. The biological activity has been patented[AC0168]. Methanol extract of the fresh bulb, at a concentration of 100.0 mcg/ml, was active on the rat platelets. Ether-soluble material produced 77% inhibition and the ether-insoluble material was inactive with zero percent inhibition[AC0152].

Lipoxygenase stimulation. Essential oil of the dried entire plant, at a concentration of 0.35 mg/ml, was active on the rabbit platelets[AC0315].

Mutagenic activity. The bulb was active on *Salmonella typhimurium* TA98[AC0308]. Chloroform/methanol (2:1) extract of the bulb, on agar plate at a concentration of 100.0 mg/plate, was inactive on *Salmonella typhimurium* TA100 and TA98. The water extract was inactive on pig kidney cells LLC-PK-1 and trophoblastic-placenta cells. The effect was the same with or without metabolic activation[AC0248]. Ethanol (95%) extract of the dried bulb, on agar plate at a concentration of 10.0 mg/plate, was inactive on *Salmonella typhimurium* TA102 and TA98[AC0142]. The fresh bulb, on agar plate at a concentration of 1.2 mg/plate, was active on *Salmonella typhimurium* TA1535, and inactive on TA98. A concentration of 2.4 mg/plate was active on TA1537 and TA1538[AC0328]. Water extract of the fresh bulb, on agar plate, was inactive on *Salmonella typhimurium* TA100[AC0310].

Nucleotidase inhibition. Water extract of the fresh bulb, administered intragastrically to rats, was active on RBC[AC0320].

Phorbol ester antagonist. The essential oil, applied externally to female mice at a dose of 5.0 mg/animal, was active. The dose was applied 1 hour before application of 12-0-tetradecanoyl-phorbol-13-acetate. Sixteen hours later, the rate of DNA synthesis was decreased by 79%[AC0211]. The fresh bulb was active vs phorbol myristate acetate-induced decrease in glutathione peroxidase, and stimulation of ornithine decarboxylase[AC0323].

Plant germination inhibition. Water extracts of the dried leaf and dried stem, at a concentration of 500.0 gm/liter, were active on the seeds of *Cuscuta reflexa* after 6 days of exposure to the extract[AC0218].

Plant growth inhibition. Water extract of the dried stem, at a concentration of 500.0 gm/liter, was active on *Cuscuta reflexa*. Seedling length, weight, and dry weight were measured after 6 days of exposure to the extract[AC0218].

Plant pollen tube elongation inhibition. The fresh bulb, at a concentration of 0.3 gm/well, was active vs *Camellia sinensis* pollen[AC0391]. Water extract of the bulb, at a concentration of 0.001%, was active on *Calotropis gigantea*[AC0287].

Plasminogen activation stimulation. Water extract of the fresh bulb was active[AC0263].

Platelet adhesion inhibition. The essential oil, administered by gastric intubation to male rabbits at a dose of 2.0 gm/kg for 3 months, was active. Results significant at $p < 0.001$ level[AC0278].

Platelet aggregation inhibition. Butanol extract of the bulb, at a dose of 20.0 microliters, was active on human platelets vs ADP-induced aggregation. Ethanol-insoluble fraction, at a concentration of 20.0 microliters, was active vs ADP-induced aggregation. One out of 6 fractions extracted showed activity[AC0277]. Butanol extract of the fresh bulb, taken orally by adults at a dose of 200.0 gm/person, was active. The subjects consumed a high fat meal prior to testing[AC0296]. Chloroform extract of the bulb, at variable dosage levels, was active on platelets of humans and rabbits. Platelet aggre-

gation was inhibited by the blocking of thromboxane synthesis[AC0240]. The essential oil, at concentrations of 10 to 30 mcg/ml, produced strong activity in human adults vs ADP-induced aggregation. There was induction of a redistribution of the products of lipoxygenase pathway. Concentrations of 30 to 60 mcg/ml also produced strong activity vs ADP-induced aggregation. There was complete suppression of the formation of all oxygenase products[AC0252]. The essential oil produced weak activity on human platelets vs ADP-induced platelet aggregation[AC0247]. Water extract of the fresh bulb, in cell culture at a dose of 10.0 microliters, was active vs ADP-induced aggregation[AC0209]. A dose of 30.0 microliters was active vs collagen-, epinephrine- and arachidonic acid-induced aggregation[AC0206]. Water extract of the fresh bulb was active vs ADP- and arachidonic acid-induced platelet aggregation[AC0244].

Pro-oxidant activity. The fresh bulb, at a concentration of 1.0%, was active. The effect was observed at 140 degrees Fahrenheit in peanut oil[AC0390].

Prostaglandin inhibition. Water extract of the fresh bulb, in cell culture, was active on platelets[AC0206] and on the rat aorta[AC0209].

Protein synthesis inhibition. The fresh bract, in buffer, was active, IC_{50} 60.0 mcg protein/ml[AC0210].

Quinone reductase induction. Acetonitrile extract of the dried bulb, in cell culture at a concentration of 7.9 mg/gm, was active on mice hepatoma-ICIC7. Assay was conducted to determine the induction of detoxifying enzyme, an effect that may have anticarcinogenic activity[AC0155].

Respiratory depressant. Ethanol (95%) extract of the bulb, administered intravenously to dogs at a dose of 100.0 mg/kg, was inactive[AC0223].

Respiratory stimulant effect. Ethanol (95%) extract of the bulb, administered intravenously to dogs at a dose of 100.0 mg/kg, was inactive[AC0223].

Smooth muscle relaxant activity. Ethanol (95%) extract of the bulb, administered by perfusion to guinea pig lung at a dose of 5.0 mg, was active[AC0223].

Smooth muscle stimulant activity. Chromatographic fraction of the fresh bulb was active on the stomach (fundus)[AC0198]. The fresh bulb juice was active on the rat intestine[AC0340].

Spermicidal effect. The essential oil was active in guinea pigs[AC0339].

Superoxide inhibition. Lyophilized extract of the fresh bulb, in the ration of chicken at a concentration of 2.0% of the diet, was active. Mn-superoxide dismutase activity was stimulated[AC0141].

Sympathomimetic activity. Water extract of the dried bulb, administered intravenously to cats at a dose of 0.05 mg/ml, was active. A concoction of *Nicotiana tabacum* leaf, *Ocimum basilicum* leaf, *Allium sativum* leaf, *Allium cepa* bulb, *Allium ascabricum* bulb, *Citrus limon* fruit juice, cow's urine, and trona (an alkaloid mineral substance) was used. The treatment enhanced the contractile response of the cat nictating membrane evoked by preganglionic cervical sympathetic nerve stimulation. At a higher dose, it caused contraction without nerve stimulation[AC0283].

Thromboxane B-2 inhibition. Chloroform extract of the bulb, at variable dosage levels, was active on human platelets vs incubation with labeled arachidonic acid[AC0240].

Thromboxane B-2 synthesis induction. The fresh bulb, taken orally by adults at a dose of 5.0 gm/person on days 1 to 7, was inactive[AC0200].

Thromboxane B-2 synthesis inhibition. Chloroform and ether extracts of the fresh bulb juice, at a concentration of 0.001 mg/ml, were active[AC0197]. Essential oil of the dried entire plant was active on rabbit plate-

lets, IC_{50} 0.125 mg/ml[AC0315]. Ether extract of the fresh bulb juice, in cell culture, was active on fibroblasts-human-lung and platelets[AC0207]. Water extract of the fresh bulb, in cell culture, was active[AC0244].

Toxic effect (general). Butanol extract of the fresh bulb, in the ration of dogs at undiluted concentration, was active. A pug puppy was referred to a Veterinary college. The dog had a depraved appetite and preferred raw onion to other vegetables, which led to anemia in the dog[AC0253].

Tumor necrosing factor induction. The fresh bulb juice, administered intravenously to mice at a dose of 200.0 microliters/animal, was active. Three hours after priming TNF production with the juice, intravenous injection of OK-432 or IFN-Gamma was used to trigger TNF production. Two hours later, TNF was assayed by its cytotoxicity against L929 cells[AC0216].

Tumor promoting effect. Hot water extract of the fresh bulb, applied externally to mice at a dose of 10.0 mg/animal, was active. The dose was applied 3 times weekly for 49 to 60 weeks after tumor initiation vs DMBA-induced carcinogenesis[AC0323].

Tumor promotion inhibition. Ethyl acetate extract of the fresh root, in cell culture at a dose of 200.0 mcg, was active on Epstein-Barr virus vs 12-0-Hexadecanoylphorbol-13-acetate-induced Epstein-Barr activation. The methanol extract was inactive[AC0316].

Uricosuric activity. Benzene/chloroform (6:4) and ether extracts of the fresh onion juice and the essential oil, diluted to the same concentration as in fresh onion juice and administered intragastrically to rats at a dose of 5.0 ml/kg for 42 days, were inactive. Urinary urea content was increased transiently, then decreased below the level of the vehicle-treated controls. Allantoin level in the urine was greater than that in the control group. The methanol extract of fresh onion juice, diluted to the same concentration as in fresh onion juice and administered intragastrically to rats at a dose of 5.0 ml/kg for 42 days, was inactive[AC0319].

Uterine stimulant effect. Fresh bulb juice was active on the uterus of rats[AC0340]. Water extract of the bulb, at a concentration of 15.0 mg/ml, produced weak activity. The treatment was equivalent to 0.003 IU of oxytocin[AC0104]. Water extract of the bulb was active on non-pregnant, and produced strong activity on pregnant mice and rats[AC0109].

WBC macrophage stimulant. Water extract of the freeze-dried bulb, at a concentration of 2.0 mg/ml, was inactive on sarcoma (Yoshida ASC). Nitrite formation was used as an index of the macrophage stimulating activity to screen effective foods[AC0214].

WBC stimulant. Fresh bulb juice, administered intraperitoneally to mice, was active. Neutrophil accumulation was increased 78%, ED_{50} 0.15 ml/animal[AC0140].

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2 Althaea officinalis

L.

Common Names

Altea	France	Khatmi	India
Altea	Peru	Marsh mallow	USA
Althea	USA	Marsh mallow	USSR
Bardul Khatmi	India	Marsh mallow	Bolivia
Bon visclo	France	Marsh mallow	Poland
Eibisch	France	Malva blanca	France
Erva molle	Italy	Malvavisco	Bolivia
Guimauve	France	Malvavisco	Peru
Guimauve	Tunisia	Marmolone	Italy
Hobbiza	Tunisia	Suzmool	India
Khairi	Arabic countries	Sweet weed	USA
Khatmi-ka-phool	India	Wymote	USA

BOTANICAL DESCRIPTION

This perennial herb of the MALVACEAE family is a 60–120 cm high hardy, velvety plant that has an erect root up to 50 cm long and a few cm thick with secondary roots. The succulent stem is usually woody at the base and unbranched. The leaves are short-petioled with an ovate, acute leaf-blade. The secondary leaves are narrow and drooping. The lower leaves are 5-lobed, the upper cauline leaves are often triangular, more wide than long. The reddish-white flowers are usually in axillary or terminal clusters; the 6–9 sepals of the epicalyx are fused at the base, and are 8–10 mm long and pointed; 5 sepals, 5 heart-shaped petals and numerous stamens are fused together with the anthers to a column. The ovaries in a ring, numerous styles; mericarps smooth and downy. The 5-8 mm fruit is disc-like and breaks up into the mericarps that are downy on the outside and often have fine, branched, radiating ribs. The seeds are dark-brown, glabrous, kidney-shaped and somewhat compressed.

ORIGIN AND DISTRIBUTION

A native of the British Isles and the temperate regions of India, it is now distributed throughout Europe and can be found in parts of the Americas.

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

TRADITIONAL MEDICINAL USES

Arabic countries. Hot water extract of the plant is taken orally as an abortifacient and emmenagogue in Unani medicine[AO0133].

Bolivia. Infusion of the plant is taken orally as an expectorant[AO0134].

France. Infusion of the flower and leaf is taken orally as an emmolient and externally as an antiseptic[AO0113].

India. Infusion of the dried flower is taken orally as an expectorant[AO0108]. The root, boiled with black pepper, is taken orally for asthma[AO0114].

Italy. Decoction of the dried root is taken orally for constipation[AO0139]. Decoction of the flower and leaf is taken orally as an antiasthmatic[AO0110]. Infusion of the root is taken orally for bronchial catarrh and as a gastric protective[AO0110].

Peru. Hot water extracts of the dried flower and the dried leaf are used externally as an emollient[AO0138]. Hot water extract of the dried root is used externally as an emollient[AO0138].

Tunisia. The dried leaf is used as a cicatrizant[AO0135].

USA. Hot water extract of the dried root is taken orally as an expectorant and externally as a demulcent[AO0141]. Infusion of the dried leaf is taken orally to treat cystitis[AO0107]. The root is taken orally for coughs and sore throat[AO0104].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Aesculetin: Aer, Rt[AO0108]
Aesculin: Aer, Rt[AO0108]
Alanine: Rt[AO0105]
Althaea D-glucan: Lf[AO0131]
Althaea mucilage O: Rt 0.22%[AO0129]
Althaea mucilage OL: Lf 550[AO0101]
Althaea mucilage polysaccharide: Rt[AO0117]
Althaea mucopolysaccharide: Rt[AO0116]
Arabinofuranan, L: Rt[AO0115]
Asparagine: Rt[AO0105]
Asparaginic acid: Rt[AO0105]
Astragalin: Fl[AO0111], Lf[AO0103]
Benzoic acid, 4-hydroxy: Lf[AO0130], Fl[AO0121], Rt[AO0102]
Butyric acid, 4-amino: Rt[AO0105]
Caffeic acid: Fl[AO0106], Lf[AO0130], Rt[AO0102]
Cichorin: Aer, Rt[AO0108]
Chlorogenic acid: Fl[AO0121]
Coumaric acid, para: Lf[AO0130], Fl[AO0121], Rt[AO0102]
Coumarin: Aer, Rt[AO0108]
Diosmetin, 8-hydroxy-3-sulfo-8-0-beta-D-glucoside: Lf[AO0130]
Diosmetin, 8-hydroxy 8-0-beta-D-glucoside: Lf[AO0103]
Diosmetin, 8-hydroxy 8-0-beta-D-glucoside-3-sulfate: Lf[AO0103]
Ferulic acid: Lf[AO0130], Fl[AO0121], Rt[AO0102]
Herniarin: Aer, Rt[AO0108]
Hypolaetin, 8-0-gentiobioside: Fl[AO0125]
Hypolaetin-4-methyl ether-8-0-glucoside-3-sulphate: Lf[AO0124]
Hypolaetin-4-0-methyl-ether-8-0-beta-D-glucoside: Fl[AO0125]
Hypolaetin-8-0-gentiobioside: Lf, Fl[AO0111]
Hypolaetin-8-beta-gentiobioside: Lf[AO0120]
Hypoletin-8-glucoside: Lf[AO0120]
Kaempferol, dihydro, 4-0-beta-D-glucoside: Fl[AO0125]
Kaempferol, dihydro, 4-0- beta-D: Fl 0.76-0.84%[AO0126]
Kaempferol, dihydro, 4-0-glucoside: Lf, Fl[AO0111]
Kaempferol-3-0-beta-D-(6-0-para-hydroxycinnamoyl)-glucoside: Lf[AO0130]
Luteolin, beta-hydroxy, 8-gentiobioside: Fl[J13059]
Mucilage (Althaea officinalis): Pl 18-21%[AO0122]
Naringenin-4-0-beta-D-glucoside: Fl[AO0125]
Naringenin-4-0-glucoside: Fl[AO0124]
Phenyl-acetic acid, para-hydroxy: Lf, Fl[AO0123]
Phenylacetic acid, para-hydroxy: Rt[AO0102], Lf[AO0130], Fl[AO0106]
Polysaccharide (Althaea officinalis): Rt[AO0119]
Populnin: Fl[AO0121]
Protocatechuic acid: Lf, Fl[AO0123]
Quercitrin, iso: Fl[AO0121], Lf[AO0130]
Salicyclic acid: Fl[AO0106], Lf[AO0130], Rt[AO0102]
Scopoletin: Lf[AO0130], Fl[AO0123], Rt[AO0102], Aer[AO0108]

Scopoletin, iso: Aer, Rt[AO0108]
Scopolin: Aer, Rt[AO0108]
Scutellarein, iso, 4-methyl ether 8-0-beta-D-glucoside-2-potassium sulfate: Rt 21[AO0102]
Scyllitol: Lf 800[AO0140]
Sinapic acid: Lf, Fl[AO0123]
Spiraeoside: Lf, Fl[AO0124]
Syringic acid: Lf[AO0130], Fl[AO0106], Rt[AO0102]
Tiliroside: Lf 0.13-0.25%, Fl 0.15-0.19%[AO0126]
Umbelliferone: Aer, Rt[AO0108]
Valine: Rt[AO0105]
Vanillic acid: Fl[AO0121], Lf[AO0130], Rt[AO0102]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Antibacterial activity. Ethanol (95%) and water extracts of the flower, leaf and root, on agar plate, were inactive on *Escherichia coli* and *Staphylococcus aureus*[AO0100]. Ethanol (95%), hexane and water extracts of the dried seed, at a concentration of 10.0 mg/ml, were inactive on *Corynebacterium diphtheriae*, *Diplococcus pneumoniae*, *Staphylococcus aureus*, *Streptococcus pyogenes* and *Streptococcus viridans*[AO0127].

Anticomplement activity. Polysaccharide fractions of the dried leaf and dried root, at a concentration of 500.0 mcg/ml, were active on human serum[AO0137].

Antifungal activity. Ethanol (95%), water and hexane extracts of the dried seed, on agar plate at a concentration of 10.0 mg/ml, were inactive on *Microsporum canis*, *Microsporum gypseum*, *Phialophora jeanselmei*, *Piedraia hortae* and *Trichophyton mentagrophytes*[AO0127].

Anti-inflammatory activity. Ethanol (80%) extract of the dried root, administered by gastric intubation to male rats at a dose of 100.0 mg/kg, was inactive vs carrageenin-induced pedal edema[AO0118].

Antimycobacterial activity. Ethanol (95%) extract of the flower, leaf and root, on agar plate, was inactive on *Mycobacterium tuberculosis*[AO0100].

Antitussive activity. Polysaccharide fraction of the dried root, administered intragastrically to cats at a dose of 50 mg/kg, was equivocal, and a dose of 100.0 mg/kg was active vs cough elicited by laryngopharyngeal and tracheobronchial mucosal stimulation[AO0128].

Antiviral activity. Ethanol (80%) extract of the freeze-dried entire plant, in cell culture at variable concentrations, was inactive on adenovirus, coxsackie B2 virus, Herpes virus type 1, measles virus, poliovirus 1 and Semlicki-Forest virus vs plaque-inhibition[AO0132]. Water extract of the dried leaf, in cell culture at a concentration of 10.0%, was inactive on Herpes virus type 2, influenza virus A2(Manheim 57), poliovirus 11 and vaccinia virus[AO0136].

Antiyeast activity. Ethanol (95%), water and hexane extracts of the dried seed, on agar plate at a concentration of 10.0 mg/ml, were inactive on *Candida albicans* and *Candida tropicalis*[AO0127].

Common cold relief. Hot water extract of the dried seed, taken orally by adults at a dose of 20 gm/person, was active[AO0142].

Cytotoxic activity. Water extract of the flower, leaf and root, in cell culture at a concentration of 10%, was inactive on Hela cells[AO0136].

Radical scavenging effect. Ethanol/water (1:1) extract of the dried entire plant, at a concentration of 5.0 mcg/ml, produced weak activity vs superoxide anion when estimated by the neotetrazolium method[AO0112].

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3 Anacardium occidentale

L.

Common Names

Amaranon	Cuba	Kashumavu	India
Caju	Brazil	Kasjoe	Surinam
Caju	Portugal	Kubisa	Senegal
Cajueiro	Brazil	Kusu	Guinea
Cashew apple	Brazil	Maranon	Colombia
Cashew apple	India	Maranon	Guatemala
Cashew bark	Jamaica	Maranon	Nicaragua
Cashew nut tree	India	Maranon	Panama
Cashew nut	Brazil	Maranon	Peru
Cashew nut	India	Mbiba	Tanzania
Cashew nut	USA	Mbibo	Tanzania
Cashew tree	South Africa	Merey	Colombia
Cashew	Guyana	Mkorosho	Tanzania
Cashu	Peru	Munthamaamidi	India
Caujil	Colombia	Noix d'acajou	West Indies
Chura	Colombia	Noix de cajou	Senegal
Kadu	Senegal	Pom kajou	Haiti
Kaju badam	India	Pom	West Indies
Kaju badam	India	Pomme d'acajou	Guinea
Kaju	India	Pomme d'cajou	West Indies
Kaju	Nigeria	Pommier cajou	Senegal
Kajutaka	India	Somo	Guinea
Kajutaka	India	Uri	Nicaragua
Kasantaya	Nicaragua	Yalage porto	Guinea
Kasau	Nicaragua		

BOTANICAL DESCRIPTION

A hardy and drought resistant plant of the ANACARDIACEAE family that grows to a height of up to 12 m. The leaves are alternate, ovate, 15–20 cm long, prominently veined in pale green, and of a leathery texture. The flowers are in panicles at the ends of the branches and may be purely male or bisexual. Only a few flowers in the panicle develop into fruits. The fruits are kidney-

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shaped and are attached to the fleshy, swollen fruit stalk. The fruit stalk is shiny red and is known as the 'cashew-apple', while the true fruit or nut hangs from the enlarged end.

ORIGIN AND DISTRIBUTION

The cashew is native to the relatively dry areas of the Caribbean and the northern region of South America. It is now cultivated throughout the tropics for the "cashew nut".

TRADITIONAL MEDICINAL USES

Brazil. Hot water extract of the leaf is taken orally for diabetes[AO0136].

Colombia. The seed is taken orally as an aphrodisiac and to treat impotence[AO0101].

Cuba. The seed, toasted and powdered, is mixed with sugar and taken orally as an aphrodisiac[AO0166].

Europe. Decoction of the dried kernel is taken orally for diabetes mellitus[AO0135].

Ghana. Hot water extract of the dried bark is taken orally by women to increase fertility. Hot water extract of the dried fruit is used as a wash to treat yaws[AO0150]. The peeled twig is used as a chewing stick[AO0151].

Guinea. The unripe fruit juice is taken orally to treat hemorrhage and diarrhea. The ripe fruit juice is taken orally as a diuretic and anti-scorbutic[AO0100].

Haiti. Decoction of the bark is taken orally for amenorrhea[AO0158].

India. Exudate of the fresh pericarp is used externally as an emollient for cracking skin on the feet and to prevent termite attack. The dried seed is taken orally as an aphrodisiac[AO0154]. The fresh fruit juice is used externally as an insecticide[AO0168]. Hot water extract of the dried kernel is taken orally as an aphrodisiac[AO0131].

Jamaica. Hot water extract of the dried bark is taken orally for diabetes[AO0147].

Madagascar. Water extract of the bark is taken orally as an antidysenteric, hypotensive and hypoglycemic[AO0125].

Panama. Hot water extract of the bark is used externally to treat inflammation of the extremities and orally to treat diarrhea. Hot water extract of the entire plant is taken orally for hypertension and as a diuretic. The fruit is eaten on an empty stomach to treat throat pain[AO0148].

Peru. Hot water extract of the dried fruit and seed is taken orally as an antidysenteric, antihemorrhagic, purgative and respiratory stimulant. It is used externally as an antiinflammatory and for warts[AO0161].

Senegal. Hot water extract of the fruit, together with *Securinega virosa*, is taken orally as an aphrodisiac[AO0106]. Water extract of the dried bark is taken orally as an antidiarrheal[AO0145].

Tanzania. Water extract of the leaf is taken orally for diarrhea[AO0162].

Thailand. Hot water extract of the dried leaf is taken orally for diabetes[AO0165].

West Indies. Hot water extract of the leaf is used externally to wash ulcers. Hot water extract of the trunk and bark is taken orally as an aphrodisiac. The juice of the seed is taken orally for uterine disorders[AO0147].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Acetophenone: Fr pulp[AO0144]
Afzelechin, epi (-): Testa[AO0113]
Agathisflavone: Lf[AO0130]
Aluminum: Kernel[AO0137]
Amyrin, alpha: Sd[AO0118]
Anacardic acid (diene): Nutshell[AO0108]
Anacardic acid (monoene): Nutshell[AO0108]
Anacardic acid (triene): Nutshell[AO0108]
Anacardic acid: Sd[AO0116], Nutshell 77.43%[AO0126]
Anacardol: Sd[AO0116]
Apigenin: Lf[AO0130]
Arachidic acid: Sd[AO0117]
Arachidyl alcohol, iso: Sd[AO0118]
Arachidyl alcohol: Sd[AO0118]
Ascorbic acid: Fr[AO0140]
Benzaldehyde: Fr pulp[AO0144]
Benzoic acid 3,4,5-trimethoxy ethyl ester: Gum 0.15%[AO0110]
Benzoic acid para-hydroxy: Lf[AO0125]

Butan-1-al 3-methyl: Fr pulp[AO0144]
Calcium: Kernel[AO0137]
Campesterol: Sd[AO0118], St Bk[AO0132]
Capric acid: Sd[AO0117]
Car-3-ene: Fr pulp[AO0144]
Cardanol, 6-methyl: Nutshell[AO0104]
Cardanol: Sd[AO0115], Nutshell 1.21-9.17%[AO0126]
Cardol, 2-methyl: Sd[AO0114], Nutshell 1.7-2.6%[AO0126]
Cardol: Nutshell 15-20%[AO0126], Sd[AO0115]
Caryopyllene: Fr pulp[AO0144]
Catechin, (+): Testa 4.0%[AO0111]
Catechin, epi (-): Testa[AO0111], Sd coat[AO0143]
Chloride: Kernel[AO0137]
Cholesterol: St Bk[AO0132]
Chromium: Fr[AO0136]
Cycloartanol, 24-methyl: Sd[AO0118]
Cycloartenol: Sd[AO0118]
Cyclohexane, ethyl: Fr pulp[AO0144]
Digallic acid, meta: Fl[AO0109]
Docosan-1-ol: Sd[AO0118]
Eicosane, n: Sd[AO0118]
Elaidic alcohol: Sd[AO0118]
Ethyl acetate: Fr pulp[AO0144]
Fatty acids: Sd oil[AO0164]
Furfural: Fr pulp[AO0144]
Gadoleic acid: Sd[AO0117]
Gallic acid ethyl ester: Gum[AO0110], Fl 3.0%[AO0109]
Gallic acid methyl ester: Fl[AO0109]
Gallic acid: Fr[AO0141]
Gentisic acid: Lf[AO0125]
Heneicosane, iso: Sd[AO0118]
Heneicosane, n: Sd[AO0118]
Hentriacontane, n: Sd[AO0118]
Heptacosan-1-ol: Sd[AO0118]
Heptacosane, n: Sd[AO0118]
Hexacosan-1-ol: Sd[AO0118]
Hexacosane, iso: Sd[AO0118]
Hexacosane, n: Sd[AO0118]
Hexadecadienoic acid: Sd[AO0117]
Hexadecan-1-ol: Sd[AO0118]
Hexan-1-al: Fr pulp[AO0144]
Hex-cis-3-en-1-ol: Fr pulp[AO0144]
Hex-trans-2-en-1-al: Fr pulp[AO0144]
Hyperoside: Fl[AO0109], Fr[AO0141]
Kaempferol: Lf[AO0130]
Lauric acid: Sd[AO0117]
Leucocyanidin: Fl[AO0109]
Leucodelphinidin: Fl[AO0109]
Limonene: Fr pulp[AO0144]
Linoleic aicd: Sd[AO0117]
Linolenic acid: Sd[AO0117]
Magnesium: Kernel[AO0137]
Malic acid: Fr[AO0140]
Montanyl alcohol, iso: Sd[AO0118]
Myricetin: Lf[AO0130], Fr[AO0141]
Myristic acid: Sd[AO0117]
Myristoleic acid: Sd[AO0117]
Naringenin: Shell 330[AO0146]
Nonan-1-al: Fr pulp[AO0144]
Nondecaan-1-ol: Sd[AO0118]
Nondecane, n: Sd[AO0118]
Non-trans-2-en-1-al: Fr pulp[AO0144]
Occidentoside: Pericarp 160[AO0142]
Octacosan-1-ol, iso: Sd[AO0118]
Octanoic acid ethyl ester: Fr pulp[AO0144]
Oleic acid: Sd[AO0139]
Palmitic acid: Sd[AO0117]
Palmitoleic acid: Sd[AO0117]
Pentacosan-1-ol, iso: Sd[AO0118]
Pentacosane, iso: Sd[AO0118]
Pentacosane, n: Sd[AO0118]
Pentadecan-1-ol: Sd[AO0118]
Pentan-1-ol, 2-methyl: Sd[AO0144]
Phellandrene, alpha: Fr pulp[AO0144]
Phenol, 3-(8-cis-11-cis14-pentadecatrienyl): Nutshell [AO0122]
Phenol, 3-(8-cis-11-cis-pentadecadienyl): Nutshell[AO0122]
Phenol, 3-(8-cis-pentacecenyl): Nutshell[AO0122]
Phenol, 3-(pentadeca-cis-8,11,14-trienyl): Nutshell[AO0133]
Phenol, 3-(pentadeca-cis-8-cis-11, 14-trienyl: Nutshell[AO0127]
Phenol, 3-(pentadeca-cis-8-cis-11-dienyl): Nutshell EO[AO0133]
Phenol, 3-(pentadeca-cis-8-cis-12-dienyl): Nutshell[AO0120]
Phenol, 3-(pentadec-cis-8-enyl): Nutshell 0.825%[AO0127]
Phenol, 3-pentadeca-cis-8-cis-11-dienyl: Nutshell 0.855%[AO0127]
Phenol, 3-pentadecyl: Nutshell[AO0122]
Phenylacetaldehyde: Fr pulp[AO0144]
Phosphorous: Kernel[AO0137]
Potassium: Kernel[AO0137]
Protein: Sd 25.41%[AO0163]
Protocatechuic acid: Lf[AO0125], Fr[AO0141]
Prunin-6-O-para-coumarate: Shell 330[AO0146]
Quercetin: Lf[AO0130], Fr[AO0141], Fl[AO0109]

Quercetin-3-galloyl-glucoside: Lf[AO0125]
Quercitrin, iso: Lf[AO0130]
Quercitrin: Lf[AO0130]
Quercitroside, iso: Lf[AO0125]
Resorcinol, 2-methyl-5-(8-cis-11-cis-14-pentadecatrienyl): Nutshell[AO0122]
Resorcinol, 2-methyl-5-(8-cis-pentadecadienyl): Nutshell[AO0122]
Resorcinol, 2-methyl-5-(8-cis-pentadecyl): Nutshell[AO0122]
Resorcinol, 2-methyl-5-(pentadeca-cis-8-cis-11,14-trienyl): Nutshell EO 0.995%[AO0127]
Resorcinol, 2-methyl-5-(pentadeca-cis-8-cis-11-dienyl): Nutshell[AO0120], Sd 1.0%[AO0127]
Resorcinol, 2-methyl-5-(pentadec-cis-8-enyl): Sd 1.0%[AO0127], Nutshell EO 0.105%[AO0127]
Resorcinol, 2-methyl-5-pentadecyl: Nutshell[AO0122]
Resorcinol, 5-(8-cis-11-cis-14-pentadecatrienyl): Nutshell[AO0122]
Resorcinol, 5-(8-cis-11-cis-pentadecadienyl): Nutshell[AO0122]
Resorcinol, 5-(8-cis-pentadecenyl): Nutshell[AO0122]
Resorcinol, 5-(pentadeca-cis-8-cis-11, 14-trienyl): Nutshell EO 11.0%, Sd 39.0%[AO0127]
Resorcinol, 5-(pentadeca-cis-8-cis-11-dienyl): Nutshell EO 2.5%, Sd 4.38%[AO0127]
Resorcinol, 5-(pentadec-cis-8-enyl): Nutshell EO 1.4%, Sd 1.31%[AO0127]
Resorcinol, 5-pentadecyl: Nutshell[AO0120]
Robustaflavone: Lf[AO0130]
Salicylic acid, 6-(8-cis-11-cis-pentadecadienyl): Fr[AO0122]
Salicylic acid, 6-(8-cis-14-pentadecatrienyl): Fr[AO0122]
Salicylic acid, 6-(penta-cis-8-cis-11, 14-trienyl): Fr Juice 200[AO0127]
Salicylic acid, 6-(pentadeca-cis-8-cis-11, 14-trienyl): Nutshell EO 12.0%[AO0127]
Salicylic acid, 6-(pentadeca-cis-8-cis-11-dienyl): Nutshell EO 4.5%, Fr juice 100[AO0127]
Salicylic acid, 6-(pentadec-cis-8-enyl): Nutshell EO 8.0%, Fr juice 200[AO0127]
Salicylic acid, 6-(pentadecyl-cis-8-cis-11-dienyl): Nutshell[AO0120]
Salicylic acid, 6-pentadecyl: Nutshell EO[AO0133]
Salicylic acid, 6-(8-cis-pentadecyl): Fr[AO0122]
Salipurposide, (-): Pericarp 100[AO0142]
Selinene, alpha: Fr pulp[AO0144]
Sitosterol, beta: St bark[AO0132], Fl[AO0109], Sd[AO0118], Pericarp 20[AO0142]
Sodium: Kernel[AO0137]
Squalene: Sd[AO0118]
Stearic acid, iso: Sd[AO0117]
Stearic acid: Sd[AO0117]
Stigmasterol: St bark[AO0132]
Tannin: Fr[AO0140]
Terpinene, alpha: Fr pulp[AO0144]
Tetracosane, iso: Sd[AO0118]
Tetracosane, n: Sd[AO0118]
Tocopherol, alpha: Sd[AO0118]
Tocopherol, beta: Sd[AO0118]
Tocopherol, delta[AO0118]
Tocopherol, gamma[AO0118]
Toluene: Fr pulp[AO0144]
Triacontan-1-ol: Sd[AO0118]
Tricosan-1-ol, iso: Sd[AO0118]
Tricosan-1-ol: Sd[AO0118]
Tricosane, iso: Sd[AO0118]
Tricosane, n: Sd[AO0118]
Xylene, meta: Fr pulp[AO0144]
Xylene, ortho: Fr pulp[AO0144]
Xylene, para: Fr pulp[AO0144]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Allergenic activity. The pollen, administered by inhalation and intradermally to 65 patients with bronchial asthma and 10 healthy volunteers as control, at a concentration of 200 ppm, was active[AO0124].

Analgesic activity. Hot water extract of the leaf, administered intraperitoneally to mice[AO0119], and the leaf essential oil, administered intraperitoneally to rats at a dose of 300.0 mg/kg, were active vs hot plate method[AO0156].

Antibacterial activity. Ethanol (95%) extract of the dried bark (50 mg/ml) and the dried seed (100 mg/ml), on agar plate at a concentration of 0.1 ml of extract/plate, was active on *Bacillus subtilis* and *Staphylococcus aureus*[AO0159]. Ethanol/petroleum ether

extract of the dried bark, on agar plate at a concentration of 166.0 gm/ml, produced weak activity on *Staphylococcus aureus* and *Serratia marcescens*. A concentration of 333.0 gm/ml produced weak activity on *Escherichia coli* and *Proteus morganii*, and a concentration of 666.0 mg/ml produced weak activity on *Pseudomonas aeruginosa* and *Sarcina lutea*[AO0145]. Methanol (50%) extract of the leaf, in broth culture, was active on *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Bacillus subtilis*, *Proteus* species and *Staphylococcus albus*[AO0112]. Water extract of the dried leaf, on agar plate at a concentration of 166.0 mg/ml, produced weak activity on *Escherichia coli*, *Klebsiella pneumoniae*, *Serratia marcescens*, *Staphylococcus aureus*, *Proteus morganii*, *Pseudomonas aeruginosa*, *Salmonella typhosa* and *Sarcina lutea*. The tannin fraction, at a concentration of 10.0 mg/ml, was inactive on *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella typhimurium* and *Serratia marcescens*, and produced weak activity on *Sarcina lutea* and *Staphylococcus aureus*[AO0145]. Ethanol (95%) extract of the dried leaf (50 mg/ml), on agar plate at a concentration of 0.1 ml of extract/plate, was active on *Bacillus mycoides* and *Staphylococcus aureus*, and was inactive on *Escherichia coli* and *Pseudomonas aeruginosa*[AO0159]. The essential oil, on agar plate at a concentration of 1:100, was inactive on *Aerobacter aerogenes*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhosa*, *Shigella flexneri*, *Streptococcus hemolyticus* and *Vibrio cholera*, and produced weak activity on *Staphylococcus albus* and *Staphylococcus aureus*[AO0107]. The seed hull essential oil, in broth culture, was active on *Staphylococcus aureus*, MIC 12.5 mcg/ml; and *Brevibacterium ammoniagenes*, MIC 3.13 mcg/ml; *Streptococcus mutans*, MIC 3.13 mcg/ml; *Bacillus subtilis*, MIC 6.25 mcg/ml; and inactive on *Enterobacter aerogenes*, *Escherichia coli* and *Pseudomonas aeruginosa*, MICs > 1600 mcg/ml[AO0133].

Anticercarial activity. Hexane extract of the nutshell, at a concentration of 1.0 ppm, was active on *Schistosoma mansonii*[AO0128].

Antifungal activity. Ethanol (95%) extract of the dried bark, dried seed and dried leaf (50.0 mg/ml), on agar plate at a concentration of 0.1 ml extract/plate, was inactive on *Aspergillus niger*[AO0159]. The leaf essential oil, on agar plate, was active on *Trichophyton rubrum*, *Keratinomyces ajelloi*, *Microsporum gypseum*, *Trichophyton equinum*, *Trichophyton mentagrophytes* and *Trichophyton terrestris*[AO0160]. The seed hull essential oil, in broth culture, was inactive on *Penicillum chrysogenum*, MIC > 1600 mcg/ml[AO0133].

Antihyperglycemic activity. The dried kernel, in the ration of male mice at a concentration of 6.25% of the diet for 28 days, was inactive vs streptozotocin-induced hyperglycemia[AO0135].

Antihypertensive activity. Water extract of the dried bark, administered intravenously to rats, was active. The biological activity has been patented[AO0102].

Anti-inflammatory activity. Isopropanol (50%) extract of the dried bark, administered intraperitoneally to adrenalectomized rats at a dose of 6.25 mg/kg, was active vs carrageenin-induced pedal edema. The ED_{50} was 15.8 mg/kg vs acetic acid-induced writhing. The shell, administered by gastric intubation to rats at a dose of 1.0 gm/kg, was active vs carrageenin-induced pedal edema, results significant at $p < 0.05$ level. The dose was inactive vs dextran-induced pedal edema. A dose of 300.0 mg/kg was inactive vs acetic acid-induced writhing, and a dose of 500.0 mg/kg given on days 15-21, was active vs adjuvant-induced arthritis. The effect was seen on day 19. Results significant at $p < 0.05$ level. A dose of 12.5 mg/kg, administered intraperitoneally to rats on days 15-21, was active vs adjuvant-induced arthritis and dextran-induced pedal edema. The effect seen on day 20 was highly dose-dependent. Results significant

at $p < 0.05$ level. A dose of 50.0 mg/kg was active vs cotton pellet granuloma. Results significant at $p < 0.05$ level. The ED_{50} was 11.2 mg/kg vs carrageenin-induced pedal edema. To produce a decrease in number of leukocytes in exudate; the ED_{50} was 12.6 mg/kg[AO0155].

Antischistosomal activity. Hexane extract of the dried shell, at a concentration of 1.4 ppm, was active on *Schistosoma mansoni*[AO0169].

Antitumor activity. Ethanol (50%) extract of the leaf, administered intraperitoneally to mice, was active on hepatoma 129E(ASC)[AO0105].

Antiyeast activity. Ethanol (95%) extract of the dried bark, dried seed and dried leaf (50.0 mg/ml), on agar plate at a concentration of 0.1 ml extract/plate, was inactive on *Candida albicans*[AO0159]. The seed hull essential oil, in broth culture, was inactive on *Candida utilis* and *Saccharomyces cerevisiae*, MIC's > 1600 mcg/ml[AO0133].

Ascaricidal activity. The nutshell liquid, administered by gastric intubation to chickens at a dose of 1.0 gm/animal, produced weak activity, and a dose of 5.0 gm/animal was active on *Ascaridia galli*[AO0103].

Barbiturate potentiation. The leaf essential oil, administered intraperitoneally to rats at a dose of 150.0 mg/kg, was active[AO0156].

Capillary permeability decreased. The shell, administered intraperitoneally to rats at a dose of 12.5 mg/kg, was active vs histamine- and bradykinin-induced inflammation. Results significant at $p < 0.05$ level. A dose of 6.25 mg/kg was active vs 5-HT- and PgE_2-induced inflammation. Results significant at $p < 0.05$ level[AO0155].

CNS depressant activity. Hot water extract of the leaf, administered intraperitoneally to rats, blocked conditioned avoidance response similar to morphine[AO0119]. The leaf essential oil, administered intraperitoneally to rats at a dose of 300.0 mg/kg, was active vs rotarod test[AO0156].

Conditioned avoidance response decreased. The leaf essential oil, administered intraperitoneally to rats at a dose of 300.0 mg/kg, was active[AO0156].

Cytotoxic activity. Ethanol (50%) extract of the leaf, in cell culture, was inactive on CA-9KB, ED_{50} >20.0 mcg/ml[AO0105].

Dermatitis producing effect. In a case report, the fresh fruit eaten by a child caused perioral contact dermatitis[AO0123].

Fish poison. Hexane extract of the dried shell was active on *Lebistes reticulatus*, LD_{100} 10.0 ppm[AO0169]. Hexane extract of the nutshell, at a concentration of 10.0 ppm, was active on *Lebistes reticulatus*[AO0128].

Hypoglycemic activity. Ethanol (50%) extract of the dried leaf, administered orally to rabbits at a dose of 10.0 gm/kg, was inactive[AO0165]. Ethanol (50%) extract of the leaf, administered orally to rats at a dose of 250.0 mg/kg, was active[AO0105]. Hot water extract of the dried bark, administered by gastric intubation to dogs at a dose of 200.0 ml/animal, produced weak activity[AO0152]. The dried kernel, in the ration of male mice at a concentration of 6.25% of the diet for 28 days, was inactive[AO0135].

Hypothermic activity. The leaf essential oil, administered intraperitoneally to rats at a dose of 300.0 mg/kg, was active[AO0156].

Juvenile hormone activity. Acetone extract of the dried stem produced weak activity on *Dysdercus cingulatus*[AO0149].

Larvicidal activity. Hexane extract of the dried fruit peel, at a concentration of 100.0 ppm, produced weak activity on *Aedes fluviatilis*[AO0121]. Water extract of the dried seed hull was active on *Culex quinquefasciatus*. The LC_{100} was 3 mg of the dried hull per ml of water with 6 hours of exposure. The ethanol (95%) extract was active, and the ether and petroleum ether extracts produced weak activity[AO0129].

Molluscicidal activity. Ethanol (95%) and water extracts of the dried pericarp, at

a concentration of 200.0 ppm, were inactive on *Biomphalaria glabrata* and *Biomphalaria straminea*. A concentration of 500.0 ppm of the ethanol extract produced 80% mortality and the water extract produced 60% mortality on both species. Ethanol (95%) and water extracts of the dried trunk-bark, at a concentration of 1000 ppm, produced weak activity on *Biomphalaria glabrata* and *Biomphalaria straminea*[AO0167]. Hexane extract of the dried shell was active on *Biomphalaria glabrata*, LD_{50} 1.4 ppm[AO0169]. Hexane extract of the nutshell, at a concentration of 0.6 ppm, was lethal to the newly hatched *Biomphalaria glabrata*; 1.4 ppm was lethal to the adults and 18.0 ppm was lethal to the eggmasses[AO0128]. The fresh leaf essential oil, at a concentration of 1:10, was inactive on *Biophalaria glabrata*[AO0153].

Mutagenic activity. The seed oil was active on *Salmonella typhimurium* TA100 and TA98. Metabolic activation was not required for activity[AO0157].

Spontaneous activity reduction. The leaf essential oil, administered intraperitoneally to rats at a dose of 150.0 mg/kg, was active[AO0156].

Toxic effect. Hexane extract of the dried shell, administered intraperitoneally to mice, was inactive[AO0169].

Toxicity assessment. When ethanol (50%) extract of the leaf was administered intraperitoneally to mice, the maximum tolerated dose was 250.0 mg/kg[AO0105]. When the shell was administered intraperitoneally, the LD_{50} was 118.8 mg/kg in mice and 245.0 mg/kg in rats; by gastric intubation the LD_{50} was 944.1 mg/kg in mice and >4.0 mg/kg in rats[AO0155].

Tumor promoting effect. The seed oil, applied externally to mice at a dose of 1.0%, was active vs carcinogenesis induced by 7,12-dimethylbenz(a)anthracene[AO0138].

WBC-macrophage stimulant. Water extract of the freeze-dried seed, at a concentration of 2.0 mg/ml, was inactive. Nitrite formation was used as an index of the macrophage stimulating activity to screen effective foods[AO0134].

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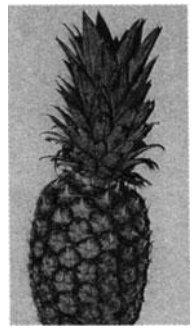
4 Ananas comosus

L.



Common Names

Ara kai	Cook Islands	Nenas	Malaysia
Alipiong	India	Painap	Fiji
Anana	Peru	Painappuru	Fiji
Ananas	Dominica	Pina comun	Puerto Rico
Ananas	Fiji	Pina	Guatemala
Ananas	French Guiana	Pina	Peru
Ananas	Gabon	Pina	Philippines
Ananas	Guadeloupe	Pina	Puerto Rico
Ananas	India	Pine	Guyana
Ananas	West Indies	Pineapple	Guyana
Ananash	India	Pineapple	USA
Anannas	India	Pineapple	Indonesia
Anannasa	India	Pineapple	Malaysia
Anaras	India	Pineapple	Dominica
Andras	Fiji	Pineapple	Fiji
Cay thom	India	Pineapple	India
Cockerell	Dominica	Pineapple	Japan
Iaiaua	West Indies	Pineapple	Tahiti
Idiaua	Dominica	Pineapple	Taiwan
Iguwu	Gabon	Pineapple	Thailand
Kateh	Thailand	Pineapple	Trinidad
Kathal saphri	India	Pineapple	West Indies
Kuraua	Dominica	Pineapple plant	India
Lagarto pina	Peru	Sap parot	Thailand
Nanas	Indonesia	Yeiawa	Nicaragua
Nanas	Malaysia	Zanana	West Indies

BOTANICAL DESCRIPTION

A periennial of the BROMELIACEAE family with short stem and usually spiny-edged leaves, 30–100 cm long and arranged in a rosette. Offshoots with small rosettes of leaves arise in the axils of the large leaves and serve to propagate the plant vegetatively. After a year or 2 the stem length-

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ens to form a spike-like inflorescence, at the end of which is a thickened axis. It consists of numerous long-pointed bracts with three-petalled flowers in their axils. The flowers become fruits without being pollinated, and the inferior ovaries develope into berries, which together with axis of the inflorescence and the bracts, form a compound fruit or syncarp. Only the roughly diamond-shaped and flattened sides of the individual fruits can be seen, making up the surface of the aggregate fruit. The upper bracts of the inflorescence do not have flowers in their axils and turn green and leaf-like. This upper part of the fruit can be cut and used for vegetative propagation.

ORIGIN AND DISTRIBUTION

The pineapple originated in the tropical regions of Brazil. It has been in cultivation since ancient times by various Indian tribes. It is now cultivated throughout the tropics.

TRADITIONAL MEDICINAL USES

Brazil. The fruit is eaten as a vermifuge, diuretic, and abortifacient[AC0140].

Cook Islands. The unripe fruit is used to treat impotence. One half of an unripe pineapple, a handful of seeds of *Ocimum basilicum* and 4 *Gardenia taitensis* flowers are pounded together into the water of a green coconut. A suitable-sized stone is heated until it is red-hot and dropped carefully into the mixture in the coconut. A man considered to suffer from tira mao or tira ngaro, or impotence, sits with the steaming coconut directed at his genitals, with a cloth wrapped around him. The healer massages him from the flanks to the genitals with coconut oil. Should the genitals retract in the steam they will return to normal with massage[AC0156].

Dominica. Unripe fruit or the juice of unripe fruit, taken orally, is used by the aborigines as an abortive agent[AC0194].

Fiji. Fresh fruit juice is taken orally for diarrhea and fresh leaf juice is taken orally for intestinal worms. Unripe fresh fruit is taken orally to terminate pregnancy (up to 3 months)[AC0187].

French Guiana. Unripe fruit is consumed by pregnant humans to provoke abortion[AC0104].

Gabon. The flower is used by female adults as an emmenagogue[AC0105].

Guadeloupe. Hot water extract of fresh unripe fruit, together with the fruit of *Achras sapota*, is taken orally to induce abortion, in particular during the fourth month of pregnancy[AC0182].

India. Hot water extract of dried flowers is taken orally by adults as an anthelmintic[AC0199]. Hot water extract of the dried leaf and ripe and unripe fruit is taken orally as an emmenagogue and abortifacient[AC0190]. Hot water extract of the dried leaf is taken orally as an anthelmintic[AC0185]. Hot water extract of dried root is taken orally as an abortifacient[AC0175]. Hot water extract of fresh ripe fruit, unripe fruit, and lead are used as an abortifacient[AC0190]. Juice from young fruit is taken orally as an abortive[AC0181]. Leaf juice is taken orally as an abortifacient and anthelmintic[AC0144]. It is also taken as an emmenagogue, to treat venereal diseases, as an anthelmintic and as a purgative[AC0140]. The juice of unripe fruit is taken in large doses as an abortifacient[AC0100,AC0199]. Unripe fruit is taken orally as an emmenagogue, expectorant, anthelmintic, diuretic and abortifacient[AC0137]. Unripe fruit juice is taken orally as an abortifacient, emmenagogue, method of criminal abortion[AC0108] and anthelmintic [AC0144]. Water extract of fruit and leaf is taken orally as an abortive[AC0127].

Indonesia. The fruit is taken orally as an abortifacient. A 4–5 cm piece of black cane stalk is pounded with half a young pineapple and taken with ragi (rice, garlic, alpinia, galanga, aromatics and spices such as cinnamon, ginger and *Capsicum annuum*). This is diluted with water and taken orally twice daily by pregnant women[AC0178]. Unripe fruit juice is taken orally as an abortifacient[AC0109] and as an emmenagogue[AC0140].

Japan. The dried fruit is used as a food to aid in digestion[AC0155].

Malaysia. Fruit juice is taken orally as an abortifacient[AC0140]. Unripe fruit juice is taken orally to prevent conception[AC0137], to produce abortion[AC0120], as a diuretic, for gonorrhea and as a vermifuge for children[AC0140]. Young inflorescence are eaten raw or sucked ad libitum as an abortifacient[AC0106]. Juice of the unripe fruit is taken raw or with salt to interfere with pregnancy[AC0126].

Mexico. Decoction of fresh fruit is taken orally as an abortifacient[AC0186].

New Caledonia. Fruit juice is taken orally as an abortifacient[AC0110].

Nigeria. Fresh fruit juice is taken orally for diabetes[AC0176]. Hot water extract of the dried bark is taken orally by adults as a treatment for arthritis[AC0176].

Peru. Fresh fruit juice is taken orally for gastrointestinal upset, weight loss and as a stomachic[AC0192].

Philippines. Juice of unripe fruit is taken orally as an emmenagogue[AC0100].

Puerto Rico. Unripe fruit juice is taken orally as a powerful emmenagogue[AC0198].

South America. Hot water extract of fresh unripe fruit is taken orally as a diuretic, expectorant, anthelmintic and as an abortive[AC0197].

Tahiti. Hot water extract of inflorescence is boiled with leaves of some herbs and the concoction is drunk to produce abortion a few hours later[AC0147].

Thailand. Hot water extract of dried root is taken orally as a diuretic[AC0200]. Juice of fresh fruit and stem is taken orally as an anti-inflammatory[AC0193].

Trinidad. Unripe fruit is used as an abortifacient. Slices of green pineapple with the skin on are boiled with flowers of silk fig (type of banana) and taken orally 2 or 3 times daily[AC0195].

USA. Fresh fruit is used as a blood purifier, to aid digestion, for gastro-intestinal disorders, diseases of the larynx and pharynx, and as a mild antiseptic and a mild stimulant[AC0201].

West Indies. Immature fruit and juice are taken orally as an abortifacient[AC0172].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

2-Methyl pentan-2-ol: Fr[AC0129]
3-Methyl pentan-3-ol: Fr[AC0129]
3,4-Benzopyrene: Fr[AC0146]
Acetaldehyde: Fr[AC0122]
Acetic acid methyl-thio-methyl ester: Fr[AC0129]
Acetic acid: Fr Ju[AC0139]
Acetone: Fr[AC0131]
Acrylic acid ethyl ester: Fr[AC0129]
Acrylic acid methyl ester: Fr[AC0129]
Alanine: Fr, Lf[AC0102]
Allyl hexanoate: Fr[AC0179]
Alpha carotene: Fr Ju[AC0132]
Alpha copaene: Fr[AC0150]
Alpha mannosidase: Fr[AC0157]
Alpha methyl butyric acid methyl ester: Fr[AC0129]
Alpha muurolene: Fr[AC0150]
Alpha terpineol: Fr[AC0129]
Alpha tocopherol: Fr 26.75-39.6 mcg/100 gm[AC0141]
Ananas comosus acid: Fr[AC0112]
Ananas comosus antiedema substance: Unripe Fr Ju[AC0128]
Ananas comosus proteolytic enzyme: St, Fr[AC0169]
Antheraxanthin (cis): Fr Ju[AC0132]
Antheraxanthin: Fr Ju[AC0132]
Arginine: Lf[AC0163]
Asparatic acid: Lf[AC0163]
ATPase: Lf[AC0162]
Auroxanthin: Fr Ju[AC0132]
Beta carotene: Fr[AC0138]
Beta mannosidase: Fr[AC0157]
Beta sitosterol: Lf[AC0144]
Beta-acetoxy caproic acid ethyl ester: Fr[AC0129]
Beta-acetoxy caproic acid methyl ester: Fr[AC0129]
Beta-acetoxy octanoic acid methyl ester: Fr[AC0129]
Beta-hydroxy caproic acid ethyl ester: Fr[AC0129]
Beta-hydroxy caproic acid methyl ester: Fr[AC0129]

Beta-hydroxy octanoic acid methyl ester: Fr[AC0129]
Beta-methyl-thio propionic acid ethyl ester: Fr[AC0129]
Beta-methyl-thio propionic acid methyl ester: Fr[AC0129]
Beta-xylosidase: Fr[AC0157]
Beta-ylangene: Fr[AC0150]
Bexzaldehyde: Fr[AC0129]
Bromelain FA-2: Fr[AC0148]
Bromelain iso-inhibitor VI: St[AC0143]
Bromelain: St 400[AC0111], Fr[AC0113], Call Tiss[AC0167], Skin 750[AC0173], Lf[AC0173]
Bromelin: Fr[AC0161]
Butan-2-ol,2,3-dimethyl: Fr[AC0129]
Butanol(iso): Fr EO[AC0136]
Butanol(tert): Fr[AC0131]
Butyl acetate(iso): Fr[AC0131]
Caffeic acid: Fr[AC0160]
Calcium oxalate: Fr[AC0122,AC0125]
Calcium: Fr Ju[AC0107]
Campestanol: Lf[AC0144]
Campesterol: Lf[AC0144]
Camphor: Fr[AC0129]
Caproic acid ethyl ester: Fr[AC0129]
Caproic acid methyl ester: Fr[AC0129]
Chlorogenic acid: Fr[AC0133]
Cis violaxanthin: Fr Ju[AC0132]
Cis-lutein: Fr Ju[AC0132]
Cis-luteoxanthin: Fr Ju[AC0132]
Citric acid: Fr[AC0130]
Cryptoxanthin: Fr Ju[AC0132]
Cyanidin-3,3',5,0-beta-D-triglucoside: Lf[AC0180]
Cyanidin-3,5,0-beta-D-diglucoside: Lf[AC0180]
Dec-cis-4-enoic acid ethyl ester: Fr[AC0129]
Dec-cis-4-enoic acid methyl ester: Fr[AC0129]
Decanoic acid ethyl ester: Fr[AC0129]
Decanoic acid methyl ester: Fr[AC0129]
Delta cadinene: Fr[AC0150]
Delta octalactone: Fr[AC0129]
Delta-acetoxy caproic acid ethyl ester: Fr[AC0129]
Delta-acetoxy octanoic acid methyl ester: Fr[AC0129]
Delta-acetoxy octanoic acid ethyl ester: Fr[AC0129]
Di-cis violaxanthin: Fr Ju[AC0132]
Dimethyl disulfide: Fr[AC0129]
Ergosterol peroxide: Lf[AC0144]
Ethanol: Fr EO[AC0136,AC0131]
Ethyl acetate: Fr[AC0131]
Ethyl Beta-methyl-thio propionate: Fr[AC0135]
Ethyl formate: Fr[AC0131]
Ethyl lactate: Fr EO[AC0136]
Ethyl propionate: Fr[AC0131]
Ferulic acid: Fr[AC0121,AC0160]
Flavoxanthin: Fr Ju[AC0132]
Formic acid: Fr Ju[AC0139]
Gamma caprolactone: Fr[AC0129]
Gamma dodecalactone: Fr[AC0129]
Gamma eudesmol: Fr[AC0129]
Gamma gurjunene: Fr[AC0150]
Gamma nonalactone: Fr[AC0129]
Gamma octalactone: Fr[AC0129]
Gamma palmitolactone: Fr[AC0129]
Germacrene D: Fr[AC0150]
Glutamic acid: Lf[AC0163]
Glycine: Lf[AC0163]
Hemicellulose 3(*Ananas comosus*): Fr Ju[AC0159]
Hemicellulose A(*Ananas comosus*): Fr Ju[AC0159]
Heptanoic acid methyl ester: Fr[AC0129]
Hex-trans-3-enoic acid ethyl ester: Fr[AC0129]
Hexan-1-al: Fr[AC0129]
Hexan-1-ol: Fr[AC0129]
Hexan-2-one: Fr[AC0129]
Hexan-3-ol: Fr[AC0129]
Hexan-3-one: Fr[AC0129]
Histidine: Lf[AC0163]
Hydroxy alpha carotene: Fr Ju[AC0132]
Iso-butyl formate: Fr[AC0131]
Iso-ethyl butyrate: Fr[AC0131]
Iso-propyl-iso- butyrate: Fr[AC0131]
Iso-leucine: Lf[AC0163]
Iso-methyl butyrate: Fr[AC0131]
Leucine: Lf[AC0163]
Linalool oxide: Fr[AC0129]
Linalool: Fr[AC0129]
Lutein: Fr Ju[AC0132]
Lutein-5,6-epoxide: Fr Ju[AC0132]
Luteoxanthin: Fr Ju[AC0132]
Lysine: Lf[AC0163]
Magnesium: Fr Ju[AC0107]
Malonic acid dimethyl ester: Fr[AC0129]
Melatonin: Fr 36.2 pcg/gm[AC0153]
Menth-1-en-4-ol: Fr[AC0129]
Methanol: Fr EO[AC0136]
Methionine: Lf[AC0163]
Methyl acetate: Fr[AC0131]
Methyl beta-methyl-thio propionate: Fr[AC0135]

Methyl formate: Fr[AC0131]
Methyl hexoate: Fr[AC0131]
Methyl iso-valerate: Fr EO[AC0136]
Methyl mercaptan: Fr[AC0129]
Methyl n-caprylate: Fr EO[AC0136]
Methyl pivalate: Fr[AC0131]
Mutatoxanthin: Fr Ju[AC0132]
Myricyl alcohol: Lf[AC0144]
Myristic acid: Lf[AC0144]
N-amyl,n-caproate: Fr EO[AC0136]
N-butyl formate: Fr[AC0131]
N-ethyl butyrate: Fr EO[AC0136]
N-ethyl caproate: Fr EO[AC0136]
N-methyl caproate: Fr EO[AC0136]
N-propyl acetate: Fr [AC0131]
N-propyl formate: Fr[AC0131]
Neochrome: Fr Ju[AC0132]
Neoxanthin: Fr Ju[AC0132]
Neurosporene: Fr Ju[AC0132]
Nonanoic acid ethyl ester: Fr[AC0129]
Nonanoic acid methyl ester: Fr[AC0129]
Oct-cis-4-enoic acid ethyl ester: Fr[AC0129]
Oct-cis-4-enoic acid methyl ester: Fr[AC0129]
Oct-trans-3-enoic acid ethyl ester: Fr[AC0129]
Oct-trans-3-enoic acid methyl ester: Fr[AC0129]
Octanoic acid ethyl ester: Fr[AC0129]
Octanoic acid methyl ester: Fr[AC0129]
Para coumaric acid: Fr[AC0121,AC0133,AC0160]
Pentan-1-ol: Fr EO[AC0136]
Pentosans: Lf[AC0166]
Peonidin-3,5-0-Beta-D-glucoside: Lf[AC0180]
Phenylalanine: Lf[AC0163]
Phytofluene: Fr Ju[AC0132]
Pipecolic acid: Lf[AC0123]
Potassium: Fr Ju 50% of ash[AC0107]
Proline: Lf[AC0163]
Propan-1-al: Fr[AC0129]
Propan-1-ol: Fr EO[AC0136]
Protein(ananas comosus): Rh[AC0114]
Protein: Fr[AC0130]
Proteinase: Lf[AC0168]
Serine: Lf[AC0163]
Sinapic acid: Fr[AC0160]
Stigmast-5-ene-3-beta-7-alpha-diol: Lf[AC0144]
Stigmastanol: Lf[AC0144]
Sucrose: Fr[AC0130]
Threonine: Lf 39.6 mcg/100 gm[AC0163]
Trollixanthin: Fr Ju[AC0132]
Tryptophan: Lf[AC0163]
Tyrosine: Lf[AC0163]
Valeric acid methyl ester: Fr[AC0129]
Valine: Lf[AC0163]
Wax(*Ananas comosus*): Fr[AC0118]
Xylan(*Ananas comosus*): Fr Pe[AC0145]
Xylitol: Fr[AC0158]
Zeta carotene: Fr Ju[AC0132]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient effect. Ethanol (95%) extract of unripe fruit, at a dose of 200 mg/kg, and water extract at a dose 100 mg/kg, were equivocal when administered orally to rats. The petroleum ether extract, at a dose of 150 mg/kg, was inactive[AC0196]. Young fruit juice, administered intragastrically to the pregnant mouse at a dose of 0.2 ml/animal, was active. Dosing was done on day 2 and 4 of pregnancy[AC0149].

Allergenic activity. The fruit, administered intradermally to adults by scratch test, produced positive results. When taken orally, Basophil degranulation test indicated positive results[AC0152]. Thirty-two patients had pruritic urticarial rashes followed by abdominal pain, vomiting and diarrhea after eating pineapple, and 20 of the patients were hypotensive[AC0151].

Anthelmintic activity. Unripe fruit juice, administered orally to cats, dogs and human adults was inactive on *Taenia saginata*[AC0117]. Water extract of the fruit juice was active on *Ascaris lumbricoides*[AC0119].

Antiallergenic activity. Water extract of the dried fruit, in cell culture at a concentration of 100.0 microliters/ml, was inactive on LEUK-RBL 2H3 vs Biotinylated anti-DNP IgE/avidin-induced Beta-hexosaminidase release[AC0155].

Antifertility effect. Ethanol (95%) and petroleum ether extracts of the rhizome, administered orally to mice, were active. The water extract was inactive[AC0101].

Antifilarial activity. The fresh leaf was active on *Setaria digitata*, LC_{100} 5200 ppm[AC0164].

Anti-implantation effect. Ethanol (95%) extract of the unripe fruit, administered orally to rats at a dose of 100 mg/kg, was

active[AC0116]. Extract of the dried leaf, administered intraperitoneally to rats, was active. The percentage effectiveness in the studies reviewed was 93%[AC0190]. Ethanol (95%) and petroleum ether extracts of the rhizome, administered orally to mice, were active. The water extract was inactive[AC0101]. Extract of the dried rhizome, administered intraperitoneally to female rats, was active[AC0190].

Anti-inflammatory activity. Water extract of fresh fruit juice, administered intraperitoneally to rats, was active. The biological activity has been patented[AC0171]. Water extract of root, administered intraperitoneally to rats, was active. The reported biological activity is highly dose-dependent[AC0171].

Antimutagenic activity. Methanol extract of the dried fruit, on agar plate at a concentration of 50.0 microliters/disc, was inactive on *Bacillus subtilis* NIG-1125 His Met and *Escherichia coli* B/R-WP2-TRP[AC0184]. Methanol extract of the dried leaf, at a concentration of 50 microliters/disc on agar plate, was inactive on *Bacillus subtilis* NIG-1125 His Met and *Escherichia coli* B/R-WP2-TRP[AC0184].

Antithiamine activity. Fresh fruit juice was active. The activity was heat-stable[AC0183].

Antithyroid activity. Boiled canned fruit, taken orally by adults at a dose of 1200 gm/person, was inactive. Iodine uptake by the thyroid was measured[AC0202].

Antitumor activity. Ethanol (95%) extract of dried entire plant, administered intraperitoneally to mice at doses of 225 and 1800 mg/kg, were inactive on colon cells 38. Doses of 50 and 200 mg/kg were inactive on Melanoma-B16, and a dose of 200 mg/kg produced weak activity on LEUK-P388[AC0191].

Antiviral activity. Undiluted fruit juice, in cell culture, produced weak activity on poliovirus[AC0170].

ATPase stimulation. Water extract of the leaf was active[AC0162].

Cytotoxic activity. Ethanol (95%) extract of dried entire plant, in cell culture, was inactive on CA-9KB, ED_{50} >100 mcg/ml[AC0191]. Ethanol/water (1:1) extract of entire plant, in cell culture, was inactive on CA-9KB, ED_{50} >20.0 mcg/ml[AC0103]. Water extract of fruit was active on leafcutter ants[AC0124].

Desmutagenic activity. Aqueous high speed supernatant of fresh fruit juice, at a concentration of 0.5 ml/plate on agar plate, was active on *Salmonella typhimurium* TA98 vs mutagenicity of L-tryptophan pyrolysis products. The assay was done in the presence of S9 mix[AC0189]. Fresh fruit homogenate, at a concentration of 100.0 microliters/disc on agar plate, was active on *Salmonella typhimurium* TA98 and TA100 vs 1,4-dinitro-2-methyl pyrrole mutagenesis[AC0188].

Embryotoxic effect. Ethanol (95%) extract of unripe fruit, at a dose of 200 mg/kg, and water extract at a dose 100 mg/kg, were equivocal when administered orally to rats. The petroleum ether extract, at a dose of 150 mg/kg, was inactive[AC0196]. Ethanol/water (1:1) extract of dried fruit, administered by gastric intubation to pregnant rats at a dose of 100.0 mg/kg, was inactive[AC0177].

Estrogenic effect. Petroleum ether extract of fruit, administered intraperitoneally to female mice, was active[AC0118].

Gastric secretory stimulation. Fruit juice taken orally by adults was active[AC0134].

Insecticidal antagonist. Chromatographic fraction of stem was active. Bromelain fractions II and III were tested[AC0174].

Peroxidase activity. Chromatographic fraction of stem was active. Bromelain fraction 1 was tested. Fractions II and III were inactive[AC0174].

Platelet aggregation stimulation. Chromatographic fraction of stem was inactive. Bromelain fractions II and III were tested[AC0174].

Protease inhibition. Water extract of fresh fruit juice was inactive. Water extract of roots was inactive[AC0171].

Proteolytic activity. Chromatographic fraction of stem was active. Bromelain fractions II and III were tested, fraction 1 was inactive[AC0174]. Chromatographic fraction of dried stem at variable concentrations was active[AC0154].

Serotonin agonist effect. Acetone extract of fresh fruit pulp was active on the rat colon and uterus. Spasmogenic activity was antagonized by bromo-LSD, an anti-5HT substance[AC0142].

Toxic effect. The entire plant, taken orally by adults, produced cystitis[AC0115]. Ethanol (95%) extract of the dried entire plant, administered intraperitoneally to mice at a dose of 400 mg/kg, was active on Melanoma-B16[AC0191].

Toxicity assessment. Ethanol/water (1:1) extract of entire plant, when administered intraperitoneally to mice, resulted in LD_{50} >1.0 gm/kg[AC0103].

WBC-Macrophage stimulant. Water extract of the freeze-dried fruit, at a concentration of 2.0 mg/ml, was inactive. Nitrite formation was used as an index of the macrophage stimulating activity to screen effective foods[AC0165].

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5 Angelica sinensis

L.

Common Names

Angelica	Europe	Kara toki	Hong Kong
Angelica	USA	Langdu danggui	China
Chinese angelica	China	Min-gui	China
Dang gui	China	Tang Kuei	China
Danggui	China	Tang-kwei	China
Dong quai	China	Tangkuei	China

BOTANICAL DESCRIPTION

A perennial of the UMBELLIFERAE family that grows to 50–250 cm. The stem is erect, often thick as an arm at the base, round, finely grooved, hollow, tinged reddish below and branched above. The leaves are very large, 60–90 cm and tri-pinnate with a hollow petiole, leaflets are ovate and unevenly serrate. The leaf sheaths are large and swollen. The flowers are greenish-white to yellowish in 20–40 rayed compact umbels, no involucre; the tiny epicalyx has numerous sepals and the tips of the sepals are minute. The petals have indented, indistinguishable tips. The elliptic fruit is 7 mm long by 4 mm wide and winged. The outer fruit membrane separates from the inner one. The rhizome is short, fleshy and has long fibrous roots. The plant has a strong tangy odor; taste is sweetish to burning tangy.

ORIGIN AND DISTRIBUTION

This species is indigenous to China. Other species with similar composition are found in the Americas, Syria, and the coast of the Baltic Sea as far north as Lapland and in Europe.

TRADITIONAL MEDICINAL USES

China. The dried entire plant is used externally for burns[AS0171]. The hot water extract is taken orally on a regular basis as a medicine [AS0127]. Hot water extract of the root is taken orally as an emmenagogue, and for menstrual disorders, amenorrhea[AS0100], dysmenorrhea, constipation, cancer, and sterility[AS0123]. Hot water extract of the dried root is taken orally for "hot flashes", to expedite childbirth and to regulate menstruation[T02276]. The dried root is taken orally in traditional Chinese medicine for the treatment of thrombo-

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angitis obliterans and acute cerebral thrombolytic diseases[AS0149]. Externally, the water extract is used to treat hyperpigmentation of the skin, such as melasma and ephelides, in order to enhance the beauty of ladies[AS0151]. Hot water extract of the dried root is taken orally to improve circulation and to dissolve blood clots[AS0156]. To promote blood circulation, to relieve heart pain and as a warming and aromatic remedy, the hot water extract of a mixture of the dried root of *Angelica sinensis*, *Aconitum carmichaellii* and *Allium macrostemon* is taken orally. Hot water extract of the dried root is taken orally for constipation, dysentery, and premenstrual syndrome, as a sedative and for irregular menstruation and amenorrhea[AS0162].

Taiwan. Hot water extract of the dried root is taken orally for liver diseases[AS0173].

USA. Hot water extract of the root is taken orally for suppressed menstruation[AS0126].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Adenine: Rt[AS0112,AS0160]
Alanine: Rt[AS0160]
Angelic acid: Pl 940[AS0149], Rt[AS0172]
Angelica polymorpha alkaloid: Rt[AS0104]
Angelica polysaccharide AS-1: Rt[AS0135]
Angelica polysaccharide: Rt[AS0110]
Angelica sinensis compound E-232: Rt[AS0108]
Angelicide: Pl[AS0107], Rt 10[T07685]
Angelicone: Rt[AS0172]
Angelol: Rt[AS0172]
Arginine: Rt[AS0159]
Aspartic acid: Rt[AS0160]
Bergapten: Rt[AS0105]
Brefeldin A: Rt[AS0159]
Butyric acid, gamma-amino: Rt[AS0160]
Cadinene, beta: Rt EO[AS0172]
Carvacrol: Rt EO[AS0172]
Choline, lysophosphatidyl: Rt[AS0147]
Choline, phosphatidyl: Rt[AS0147]
Choline: Rt 0.247%[AS0125]
Cystine: Rt[AS0160]
Dodecan-1-ol: Rt[AS0172]
Ferulic acid: Pl 940[AS0127], Rt[AS0182]
Folic acid: Rt[AS0172]
Glutamic acid: Rt[AS0159]
Glycine: Rt[AS0160]
Histidine: Rt[AS0160]
Leucine, iso: Rt[AS0160]
Leucine: Rt[AS0160]
Lignoceric acid: Rt[AS0141]
Ligustilide: Rt[AS0117], EO 45-74%[AS0114,AS0141]
Lysine: Rt[AS0160]
Malic acid, L: Rt 2.6[AS0121]
Methionine: Rt[AS0160]
Myristic acid: Rt[AS0172]
Neoangelide: Rt[AS0159]
Nephthalide, butylidene: Rt EO[AS0172]
Nicotinic acid: Rt[AS0128]
Ocimene, beta, cis: Rt EO 12.18%[AS0141]
Palmitic acid: Rt[AS0172]
Phenylalanine: Rt[AS0160]
Phthalic anhydride, 2,4-dihydro: Rt EO[AS0172]
Phthalide, butylidene: Rt[AS0128,AS0112]
Phthalide, n-butyl: Rt[AS0128]
Phthalide, n-butylidene: Rt[AS0105]
Polysaccharide (angelica sinensis): Rt[AS0129]
Proline: Rt[AS0160]
Safrol, iso: Rt EO[AS0172]
Safrole: Rt EO[AS0172]
Serine: Rt[AS0160]
Sitosterol, beta: Rt[AS0141,AS0172]
Sphingomyelin: Rt[AS0147]
Succinic acid: Rt[AS0112]
Sucrose, D: Rt[AS0105]
Sucrose: Rt[AS0100]
Tetradecan-1-ol: Rt[AS0172]
Tetradecane, N: Rt[AS0105]
Threonine: Rt[AS0160]
Tocopherol, alpha: Rt[AS0105,AS0172]
Tryptophan: Rt[AS0160]
Tyrosine: Rt[AS0160]
Umbelliferone: Rt[AS0141]
Uracil: Rt[AS0112,AS0172]
Valerophenone-o-carboxylic acid: Rt EO[AS0172]
Valine: Rt[AS0160]
Vitamin A: Rt[AS0172]
Vitamin B-12: Rt[AS0172]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient effect. Hot water extract of the dried root, in a mixture containing *Ligusticum wallichii* root, *Prunus persica* seed, *Carthamus tinctorius* flower, *Paeonia obvata*

root, *Achyranthes bidentata* root, *Leonurus sibiricus* aerial parts, *Lycopus lucidus* var. hirta leaf, *Curcuma longa*, *Curcuma aromatica* or *Curcuma zedoaria* root and *Campsis grandiflora* flowers, taken orally by pregnant women, was inactive. Hot water extract of the root, in a mixture containing *Paeonia obovata* root, *Ligusticum wallichii* flower, *Campsis grandiflora* flower, *Carthamus tinctorius* flower, *Prunus persica* seed, *Verbena officinalis* aerial parts or root, *Curcuma longa*, *Curcuma aromatica* or *Curcuma zedoaria* root, *Scirpus yagara* root bark, *Eupatorium chinense* root and *Rheum palmatum* root, was inactive. The preparation was taken in 3 doses and repeated 3 times by 41 pregnant women[AS0179]. Water extract of the root, administered intravenously to pregnant dogs and rabbits, was active[AS0104].

Acetylcholinesterase inhibition. Dichloromethane extract of the root, at a concentration of 200.0 mcg/ml, was active. Results significant at $p < 0.05$ level[AS0124].

Analgesic activity. Decoction of the dried root, in a Chinese herbal medicine that contains *Gentiana macrophylla* root, *Lycium chinense* plant, *bupleurum falcatum* root, *Anemarrhena asphodeloides* root, *Rehmannia glutinosa* root, *Paeonia albiflora* root, *Prunus mume* fruit, *Glycyrrhiza glabra* root, *Scutellaria baicalensis* root, *Paeonia moutan* root and *Lithospermum* species root, was active when administered daily for 4 weeks to a patient with diagnosis of subsepsis allergica. The clinical features of the patient were fever of long standing, arthralgia, leukocytosis and rash[AS0139]. Water extract of the root, administered intraperitoneally to mice, was inactive vs acetic acid writhing inhibition[AS0125].

Angiotensin II inhibition. Water extract of the dried root was equivocal[AS0137].

Antiamnesic activity. Dichloromethane extract of the root, administered intraperitoneally to male rats at a dose of 100.0 mg/kg, was inactive vs scopolamine-induced amnesia in passive avoidance test[AS0124].

Antianginal activity. Hot water extract of the dried root, taken orally by a patient with variant angina pectoris, in a mixture containing *Aconitum carmichaellii* and *Allium macrostemon*, was active. Given at the same time was a preparation containing *Asarum sieboldii*, *Alpinia officinarum*, *Corydalis yanhusno* and *Lignum santali*[AS0162].

Antiarrhythmic activity. Ethanol (100%) extract of the dried root, administered intravenously to rats, was active vs aconitine, epinephrine, $BaCl_2$ and digitalis-induced arrhythmia. The water extract was active vs ouabain, epinephrine, $BaCl_2$ and digitalis induced arrhythmia[AS0142]. The ethanol (95%) extract, administered intravenously to cats at a dose of 4.0 gm/kg, was active vs $ChCl_3$ or epinephrine-induced arrhythmia[AS0163].

Antiasthmatic activity. Water extract of the dried root, taken orally by adults, increased forced expiratory volume in the first second[AS0142].

Antifibrillatory activity. Ether extract of the dried root was active on dogs vs electrically- and acetylcholine-induced fibrillations[AS0142].

Antifibrinolytic activity. The water and hot water extracts of the dried root, at a concentration of 5.0 mg/ml, were inactive vs standard fibrin plate method[AS0175].

Antihemorrhagic activity. Decoction of the dried root, taken orally by a 4-year-old girl with burns over 20% of her body surface, was active. The patient was given blood transfusion and the herb preparation via nasogastric tube. After 5 days of treatment, the gastric juice was normal on examination, and after another 4 days a negative hematest stool was obtained. The general condition of the patient was markedly improved, with no signs of repetition of bleeding. The patient was earlier treated for massive gastrointestinal hemorrhage. The herbal preparation taken consists of *Panax ginseng* and *Glycyrrhiza glabra* (6 grams each), *Atractylodes macrocephala*, *Angelica sinensis*,

Polygala tenuifolia, *Euphoria longana* and *Paeonia moutan* (10 grams each), *Ziziphus spinosus* and *Gardenia jasminoides* (12 grams each), *Astragalus* species and *Bletilla* species (15 grams each) and *Agrimonia* species (30 grams)[AS0161].

Antihepatotoxic activity. Decoction of the dried root, administered by gastric intubation to rats at variable dosage levels, was active vs CCl_4 induced hepatotoxicity. The decoction taken consisted of *Angelica sinensis*, *Actractylodes macrocephala*, *Paeonia albiflora*, *Salvia miltiorrhiza*, *Artemisia scoparia*, *Astragalus membranaceus*, *Gardenia jasminoides*, *Rehmannia glutinosa*, *Paeonia moutan* and *Poria cocos*[AS0167]. The decoction, administered intraperitoneally to rats at a dose of 10.0 ml/kg, was active[AS0178]. One hundred and five patients with cirrhosis of the liver were treated for 2 to 18 months with a preparation that contained *Angelica sinensis*, *Atractylodes macrocephala*, *Paeonia albiflora*, *Salvia miltiorrhiza*, *Artemsia scoparia*, *Astragalus membranaceus*, *Gardenia jasminoides*, *Rehmannia glutinosa*, *Paeonia moutan* and *Poria cocos*. The conditions and liver functions of the majority of the patients were improved or restored to normal. Liver and spleen that were enlarged were shrunk or softened. Sixty-seven of the patients recovered, 14 showed marked improvement, 17 showed some improvement and 7 did not respond to the treatment. The patients were followed up for 3 to 6 months and relapse was noted in 13.4% of the cases[AS0166]. Water extract of the dried root was active vs D-galactosamine induced liver damage[AS0142].

Antihyperglycemic activity. Hot water extract of the dried root, in the drinking water of mice at a dose of 50.0 ml/liter, was inactive vs streptozotocin-induced hyperglycemia. The extract was in a preparation that contained *Codonopsis pilosula*, *Rehmannia glutinosa*, *Eucommia ulmoides*, *Dipsacus asperoides*, *Astragalus membranaceus*, *Loranthus parasiticus*, *Cibotium barometz* and Yu-Ma-Gen[AS0132]. Decoction of the dried root, administered intragastrically to Goldblatt hypertensive dogs at a dose of 9.0 gm/kg, was active. The decoction was composed of equal amounts of *Curculigo orchioides*, *Epimedium* species, *Morinda officinalis*, *Phellodendron chinense*, *Anemarrhena asphodeloides* and *Angelica sinensis*. Nine gm/kg was given for 10 days, then 18 gm/kg for 10 days. The dogs were then observed for 10 more days[AS0106]. The essential oil, administered intravenously to dogs, was active[AS0142]. The water extract, administered intravenously to dogs at a dose of 2.0 gm/kg, was active[AS0113].

Antihypertensive activity. The powdered dried root, in combination with *Paeonia albiflora*, *Cnidium officinale*, *Polyporaceae* and *Atractylodes* and *Alisma* species, in the drinking water of rats at a dose of 800.0 mg/kg daily for 20 days, was active[AS0133].

Antihypothermic activity. Decoction of the root, taken orally by adults, produced a decline in peripheral core temperatures slower than controls at 23 degrees Celsius[AS0165].

Antileukopenic activity. Hot water extract of the dried root, administered intragastrically to mice, was active vs cis-diamine dichloroplatinum (II) induced toxicity, ED_{50} 59.4 mg/kg[AS0121].

Antimutagenic activity. Hot water extract of the dried root, on agar plate at a concentration of 40.0 mg/plate, was inactive on *Salmonella typhimurium* TA100 and TA98 vs aflatoxin B1 induced mutagenesis. Metabolic activation had no effect on the results[AS0146].

Antinephritic effect. Decoction of the dried root, administered intragastrically to rats treated with puromycin to induce nephrosis, at a dose of 3.0 ml/animal, was active[AS0119]. A preparation of the composite extract of *Angelica sinensis*, *Panax ginseng*, *Astragalus* species, *Atractylodes japonica*, *Bupleurum falcatum*, *Zizyphus* species, *Citrus* species, *Glycyrrhiza glabra*, *Cimicifuga simplex* and *Zingi-*

ber officinale was taken orally by 53 patients with nephroptosis, at a dose of 7.5 gm/day. The patients showed improvement in lower back pain and subabdominal discomfort[AS0118]. Hot water extract of the dried root, administered intragastrically to mice, was active vs cis-diamine dichloroplatinum (II)-induced toxicity[AS0121].

Antipruritic activity. Decoction of the dried root, in a Chinese herbal medicine that contains *Gentiana macrophylla* root, *Lycium chinense* plant, *Bupleurum falcatum* root, *Anemarrhena asphodeloides* root, *Rehmannia glutinosa* root, *Paeonia albiflora* root, *Prunus mume* fruit, *Glycyrrhiza glabra* root, *Scutellaria baicalensis* root, *Paeonia moutan* root and *Lithospermum* species root, was active. The preparation was administered daily for 4 weeks to a patient with a diagnosis of subsepsis allergica. The clinical features of the patient were fever of long standing, arthralgia, leukocytosis and rash[AS0139].

Antipsoriatic activity. Decoction of the dried root, taken orally by 70 patients with psoriasis at a dose of 20.0 ml/person, was active. The dose contains *Ephedra sinica*, *Aconitum carmichaellii*, *Ligusticum wallichii*, *Atractylodes lancea*, *Angelica sinensis*, *Coix lacryma-jobi*, *Zaocys dhumnades*, and snake slough. The dose was taken twice daily for 3 to 8 weeks and for a further period of 3 weeks if no response to the initial treatment was indicated. There were 31 patients cured (44.29%) and 32 improved (45.71%). There were side effects such as nausea, anorexia, gastralgia and a mild decrease in leukocytes[AS0144].

Antipyretic activity. Decoction of the dried root, in a Chinese herbal medicine that contains *Gentiana macrophylla* root, *Lycium chinense* plant, *Bupleurum falcatum* root, *Anemarrhena asphodeloides* root, *Rehmannia glutinosa* root, *Paeonia albiflora* root, *Prunus mume* fruit, *Glycyrrhiza glabra* root, *Scutellaria baicalensis* root, *Paeonia moutan* root and *Lithospermum* species root, was active. The preparation was administered daily for 4 weeks to a patient with a diagnosis of subsepsis allergica. The clinical feaures of the patient were fever of long standing, arthralgia, leukocytosis and rash[AS0139].

Antithrombotic effect. Decoction of the dried root, administered intragastrically to rat, was active. Intravenous administration to adults produced a decline in blood viscosity and plasma fibrinogen level[AS0142].

Antithyrotropic activity. The dried entire plant, administered by gastric intubation to rats, was active. A mixture of *Salvia miltiorrhiza*, *Angelica sinensis*, *Ecklonea* species, *Prunella vulgaris* and sea shells was used[AS0164].

Antitumor activity. Hot water extract of the dried root, administered intraperitoneally to mice, was active on CA-Ehrlich-ascites. The dose was composed of a mixture of *Angelica sinensis*, *Bufo bufo*, *Solanum nigrum*, *Solanum lyratum*, *Duchesnea indica*, *Curcuma longa* and *Salvia miltiorrhiza*[AS0157]. The hot water extract, administered intravaginally to patients with uterine mycoma, was active. In 52.9% of the patients, the symptoms disappeared, and in 27.2% the tumors were reduced in size. The extract was used in combination with *Curcuma zedoaria*, *Prunus persica*, *Dipsacus asper*, *Cyperus rotundus*, *Prunella vulgaris*, *Achyranthes bidentata*, *Vaccaria segetalis*, *Sparganium stoloniferum*, *Laminaria japonica* and *Coix lacrym-jobi*[AS0181]. The polysaccharide fraction of the rhizome, administered intraperitoneally to mice at a dose of 0.4 mg/animal, was active on CA-Ehrlich-ascites[AS0120].

Antiviral activity. Decoction of the dried root, taken by a patient with atypical chronic infectious hepatitis, was active. The treatment was taken in combination with *Salvia miltiorrhiza*, *Isatis tinctoria*, *Taraxacum mongolicum*, *Paeonia lactiflora*, *Atractyloides macrocephala*, *Rehmannia glutinosa*, *Poria cocos*, *Cyperus rotundus*, *Citrus reticulata*, *Prunus mume* var. Viridicalyx and *Justicia procumbens*[AS0131].

Antiyeast activity. Hot water extract of the dried entire plant was taken orally for the treatment of systemic fungal infections. The extract was active on *Candida albicans*[AS0136].

Aphrodisiac activity. The dried root, taken orally by 737 impotent men, was active. The treatment involved taking 1.0 gram of the preparation every morning and night with wine on an empty stomach for 15 days. Within one year 655 of the men recovered with erection and successful intercourse. Seventy-seven of them improved somewhat and 5 failed to respond to the treatment. A few of the subjects had side effects such as puffiness in the face and lower part of the torso and itching in the palms of the hands and feet. The symptoms were not serious and gradually disappeared[AS0152].

Blood flow increase. The powdered dried root, in the drinking water of rats at a dose of 800.0 mg/kg daily for 20 days, in combination with *Paeonia albiflora*, *Cnidium officinale*, *Polyporaceae* and *Atractylodes* and *Alisma* species, increased placental blood flow[AS0133].

Blood system effects. Decoction of the root, when taken orally by adults, lowered the viscosity of whole blood[AS0165].

Cardiovascular effects. The dried plant, in combination with *Panax ginseng*, *Liriope spicata*, *Astragalus membranaceus* and *Salvia miltiorrhiza*, lowered the incidence of hypotension and congestive heart failure in myocardial infarction patients[AS0170].

Cerebral blood flow effect. Water extract of the dried root, administered intravenously to dogs at a dose of 2.0 mg/kg, increased the blood flow[AS0113].

Chromosome aberration inhibition. Water extract of the dried root was active vs cobalt irradiation-induced aberration in the rabbit[AS0142]. The intraperitoneal administration was inactive vs cyclophosphamide-induced damage in mice[AS0146].

Clastogenic activity. Hot water extract of the dried root, administered intraperitoneally to mice, was inactive vs cyclophosphamide-induced damage[AS0146].

Coronary blood flow effect. Water extract of the dried root, administered intragastrically and intravenously to dogs at a dose of 2.0 gm/kg, increased blood flow[AS0142].

Diuretic activity. Hot water extract of the root, administered intravenously and orally to dogs at a dose of 10.0 gm/kg, was active[AS0100].

Estrogenic effect. Hot water extract of the dried root, taken orally by female adults, was active in treating functional uterine hemorrhage[AS0158].

Fertility promotion effect. Decoction of the dried root was administered to 34 female patients at a dose of 2.0 ml/person. The patients suffered from tubal occlusion, and were treated with the compound "Danggui" by irrigation with uterographic catheter. Two ml of the decoction was diluted with normal saline to 12 ml as a dosage unit. Irrigation was performed 1 to 3 times at each menstrual period during the period from 3 days after cessation of menstruation to rise of the body temperature (follicular phase). The sessions of irrigation were given 1 to 2 days apart and withheld if vaginal bleeding occurred. The irrigation started with a small dosage and gradually increased to 5–8 dosage units per session, in general. The patients were treated for 2 to 15 sessions with 8 to 106 dosage units in total. Treatment for the 3 periods constituted 1 therapeutic course, and 1 to 3 courses were given if tubal patency was not regained after 1 course. Seventy-nine percent of the patients regained tubal patency and 66 percent of them became pregnant. The remaining patients regained tubal patency but the lumen was too narrow for good passage of iodine contrast medium[AS0177].

Glutamate pyruvate transaminase inhibition. Ethanol/water (1:1) extract of the dried root, in cell culture at a concentration of 1.0 mg/ml, was inactive vs CCl_4-induced

hepatotoxicity and PGE 1-induced pedal edema on rat liver cells[AS0173].

Hair stimulant effect. Decoction of the dried root, in combination with *Polygonum multiflorum*, *Allium sativum*, *Zingiber officinale*, *Panax ginseng*, *Carthamus tinctorius*, *Platycodon grandiflorum*, *Biota orientalis*, *Ligusticum wallichii*, *Salvia miltiorrhiza* and *Tetrapanax papyrifera*, was effective in promoting hair growth when applied topically. The biological activity has been patented[AS0115].

Hematopoietic activity. The polysaccharide fraction of the dried root promoted the formation of hemopoietic colonies on the surface of spleen of irradiated mice. The treatment also increased the rate of production of CFU-E, CFU-D and CFU-S in rats[AS0142]. The powdered dried entire plant, in a preparation containing *Rehmannia glutinosa*, *Astragalus membranaceus* and *Cyperus rotundus*, taken orally by 12 patients with aplastic anemia at a dose of 9 gm, 2–3 times daily for 3 months, was active. The patients also received another preparation containing *Panax ginseng*, *Cervus elaphus*, *Chinemys reevesii*, *Cervus* species and *Schisandra chinensis* concomitantly over the 3-month period[AS0169].

Hypotensive activity. Decoction of the dried root, administered intraduodenally to cats at a dose of 6.0 gm/kg, was active. The treatment contained equal parts of *Angelica sinensis*, *Curculigo orchioides*, *Epimedium* species, *Morinda officinalis*, *Phellodendron chinense* and *Anemarrhena asphodeloides*. Intraperitoneal administration to cats at a dose of 12.0 gm/kg, and to dogs at a dose of 6.0 gm/kg, were active[AS0106]. Water extract of the dried root, administered intravenously to dogs at a dose of 2.0 gm/kg, was active[AS0142]. Water extract of the root, administered intravenously to dogs, was active[AS0104].

Immunostimulant activity. Polysaccharide fraction of the rhizome, in cell culture at a concentration of 10.0 mcg/ml, was active on the spleen[AS0120]. Water extract of the root increased phagocytic clearance, serum antibodies and lymphocyte proliferation in the mouse[AS0142].

Immunosuppressant activity. Decoction of the dried root, administered intragastrically to mice at a dose of 200.0 mg/kg for 8 days, was active. The treatment inhibited local graft vs host response to cells. A combination of extracts of *Angelica sinensis* and *Gardenia jasminoides* was used[AS0143]. Hot water extract of the dried root, in the drinking water of mice at a dose of 50.0 ml/liter, was inactive. The dose also contained *Codonopsis pilosula*, *Rehmannia glutinosa*, *Eucommia ulmoides*, *Dipsacus asperoides*, *Astragalus membranaceus*, *Loranthus parasiticus*, *Cibotium barometz*, and "Yu-Ma-Gen". The preparation did not prevent long-term rejection[AS0132]. The dried-root heartwood, in a prescription containing *Rehmannia glutinosa*, *Paeonia lactiflora*, *Cnidium officinale*, *Scutellaria baicalensis*, *Phellodendron chinese*, *Coptis chinensis*, and *Gardenia jasminoides*, administered intragastrically to mice at a dose of 10.0 mg/kg for 4 days postimmunization, was active vs sheep red blood cell-induced footpad reaction; dosing for 7 days postimmunization was active vs tuberculin-induced footpad reactions; dosing for 8 days was active vs host reaction and 5 days of dosing postimmunization was active vs picryl chloride-induced contact dermatitis and humoral antibody formation[AS0174].

Mutagenic activity. Water extract of the plant, on agar plate at a concentration of 40.0 mg/plate, was inactive on *Salmonella typhimurium* TA100 and TA98. The extract, administered intraperitoneally to mice at a dose 10 to 40 times the dose used in medication, was inactive[AS0122].

Oxygen radical inhibition. Decoction of the dried root, at a concentration of 500.0 mcg/ml, was active. The treatment also contained "Juzentaihoto" which is composed of *Astragalus mongoholicus*, *Cinnamomum cassia*,

Rehmannia glutinosa, Paeonia albiflora, Cnidium monnieri, Atractylodes lancea, Panax ginseng, Poria cocos and *Glycyrrhiza glabra*. A concentration of 61.0 mcg/ml was inactive on the guinea pig macrophages vs inhibition of FMLP-induced superoxide anion[AS0140].

Phagocytosis stimulation. Water extract of the dried rhizome, administered intravenously to male mice at a dose of 16.0 gm/kg, was active vs clearance function of mononuclear phagocyte system as determined by the congo red clearance test. A dose of 20.0 gm/kg, administered subcutaneously, was active vs phagocytosis by peritoneal macrophages[AS0150].

Plasmin inhibition. Ethanol (95%), hot water and water extracts of the dried root, at a concentration of 60.0 mcg/ml, were inactive vs chromogenic substrate method[AS0175].

Platelet aggregation inhibition. The dried root, in cell culture, and the water and hot water extracts, administered intravenously to rats, were active vs ADP- and collagen-induced aggregation[AS0142].

Progestagenic effect. Hot water extract of the dried root, taken orally by 60 women with functional uterine hemorrhage, was active. The treatment also contained *Agrimonia eupatoria, Leonurus heterophyllus, Rehmannia glutinosa, Paeonia lactiflora, Rubia cordifolia, Panax ginseng, Codonopsis pilosula, Gardenia jasminoides, Scutellaria baicalensis, Ligusticum chuanxiong* and *Astragalus membranaceus*[AS0158].

Radioprotective effect. Water extract of the dried root, administered intravenously to mice at necrotic doses daily for 30 days post-irradiance, restored 80% of pregnancy rate vs none in controls. The polysaccharide fraction increased survival by 30 days in irradiated mice[AS0142].

Renal function improvement. Water extract of the dried root was active vs aminonucleoside-induced renal damage[AS0142].

Respiratory depressant. Decoction of the dried root, administered intraperitoneally to cats at a dose of 12.0 gm/kg, was inactive[AS0106].

Sebaceous secretion inhibition. Ethanol (95%) extract of the dried root, applied topically to hamsters at a dose of 20.0 microliters/animal, was inactive[AS0134].

Serotonin antagonist activity. Hot water extract of the dried root, at a concentration of 500.0 mg/ml, inhibited the aggregation and release of 5-HT labeled platelets induced by thrombin[AS0149].

Smooth muscle stimulant activity. Hot water extract of the root, administered intravenously to dogs at a dose of 10.0 gm/kg, was active on the urinary bladder and intestine[AS0100].

Sperm motility increased. Water extract of the dried root, at a concentration of 100.0 mg/ml, was inactive on human sperm[AS0116].

Toxic effect. Water extract of the dried root, administered intragastrically to mice at a dose of 5.0% for 15 weeks, produced no side effects. Intravenous administration to 40 patients, at a dose of 240.0 ml/person for 30 days, produced no side effects[AS0142].

Toxicity assessment. Water extract of the dried root, when administered intravenously to mice, produced LD_{50} 100.0 gm/kg[AS0142].

Tyrosinase inhibition. Methanol/water (1:1) extract of the dried root was active, ID_{50} 28.0 mg/ml[AS0151].

Uterine stimulant effect. Ethanol (95%) and water extracts of the dried root, administered intravenously to cats, dogs and rabbits, were active[AS0172]. Water extract of the root was active on the human uterus and produced strong activity on the rabbit uterus. The extract, administered intraperitoneally to rats[AS0105] and intravenously to dogs, was active[AS0104]. Hot water extract of the root was active on the non-pregnant rabbit uterus. The hot water extract, administered intravenously to dogs at a dose of 10.0 gm/kg, was active[AS0100].

Vasodilator activity. Decoction of the dried root, in combination with equal amounts

of *Curculigo orchioides*, *Epimedium* species, *Morinda officinalis*, *Phellodendron chinense* and *Anemarrhena asphodeloides*, administered intraduodenally to dogs at a dose of 12.0 gm/kg, was active. A dose of 6.0 gm/kg, administered intraperitoneally to dogs, dilated peripheral blood vessels[AS0106]. The water extract decreased vascular resistance and increased blood flow[AS0142].

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6 Azadirachta indica

A. Juss

Common Names

Azad dirakhat	India
Bewina mara	India
Bo-nim	India
Cape lilac	Indonesia
China tree	Indonesia
Chinaberry	Indonesia
Chinaberry	USA
Darbejiya	Nigeria
Dogo yaro	Nigeria
Dogonyaro	Nigeria
Gori	India
Gringging	Indonesia
Igi-oba	Nigeria
Imba	India
Indian lilac	India
Indian neem tree	Kenya
Intaran	Indonesia
Isa-bevu	India
Kiswahili	Tanzania
Kohomba	Sri Lanka
Lilas de perse	Rodrigues Islands
Limb	India
Limbado	India
Mahanim	India
Mahanimba	India
Mahnimu	India
Mala	Fiji
Margosa tree	India
Margosa tree	Nepal
Margosa	India
Mimba	India
Mindi	Indonesia
Miro Tahiti	Easter Island
Mwarobaini	Tanzania
Neeb	Tanzania
Neem	USA
Neem	Antigua
Neem	Fiji
Neem	Gambia
Neem	Guyana
Neem	India
Neem	Kenya
Neem	Nepal
Neem	Nigeria
Neem	Philippines
Neem	Sudan
Neem	Trinidad
Neem	West Indies
Nim tree	India
Nim	Fiji
Nim	India
Nim	Nepal
Nimba	India
Nimbatikta	India
Nivaquine	Senegal
Sadao India	Thailand
Sadao tree	Thailand
Sadao	Thailand
Sa-Dao	Thailand
Vembu	India
Vepa	India
Veppam	India
White cedar	Indonesia
Zanzalakhat	Saudi Arabia

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BOTANICAL DESCRIPTION

Azadirachta indica is a tropical evergreen of the MELIACEAE family that grows up to 25 m high. It has rough dark brown bark with wide longitudinal fissures separated by flat ridges. The leaves are compound, imparipinnate, each comprising 5–15 leaflets that are arranged in alternate pairs with terminal leaflets. The compound leaves are themselves alternating with one another. The thin, lanceolate leaflets measure about 6 cm long and 2 cm broad. It bears many flowered panicles, mostly in the leaf-axils. The sepals are ovate and about 1 cm long with sweet scented white oblanceolate petals. It produces yellow drupes that are ellipsoid and glabrous, 12–20 cm long.

ORIGIN AND DISTRIBUTION

A native to east India and Burma, it grows in much of Southeast Asia and West Africa, and more recently the Caribbean and South and Central America.

TRADITIONAL MEDICINAL USES

India. Hot water extract of the bark is taken orally by the adult female as a tonic and emmenagogue[AI0390]. The hot water extract of the dried fixed oil is taken orally as an emmenagogue[AI0362]. Anthraquinone fraction of the dried flower, fruit and leaf is taken orally for leprosy[AI0286]. Hot water extract of the flower and leaf is taken orally as an antihysteric remedy, and is used externally to treat wounds[AI0390]. The dried flowers are taken orally for diabetes[AI0235]. Hot water extract of the dried fruit is used for piles and externally for skin diseases and ulcers[AI0321]. Hot water extract of the entire plant is taken orally as an anthelmintic, an insecticide and a purgative[AI0390]. Juices of the bark of *Andrographis paniculata*, *Azadirachta indica* and *Tinospora cordifolia* are taken orally as a treatment for filariasis[AI0235]. Hot water extract of the bark is taken with water, orally before breakfast, for leprosy. The extract is also taken for fever and diabetes, and as a tonic, refrigerant, anthelmintic and antiperiodic [AI0296,AI0317]. The fresh fruit is used externally for leprosy[AI0296]. Fruit, leaf and root, ground and mixed with dried ginger and "trifala", a preparation consisting of the powdered fruit of *Terminalia bellerica* (Gaertn.) Roxb., *T. Chebula* Retz, and *Emblica officinalis* Gaertn., is taken orally with lukewarm water to treat common fevers[AI0195]. Leaf juice is administered by intravenous infusion for chronic skin diseases[AI0251], and is taken orally as an anthelmintic[AI0389].

Indo-China. Hot water extract of the bark is taken orally for malaria, but it is inferior to quinine. Hot water extract of the leaf is also taken orally as a treatment for malaria[AI0109].

Nigeria. Decoction of the dried bark is taken orally as a treatment for fevers, and the infusion is taken orally for malaria[AI0182]. Hot water extract of the fresh leaf and bark is taken orally to treat jaundice, to cure malaria and as a cathartic[AI0260].

Senegal. Hot water extract of the dried bark is taken orally for gingivitis, and for the healing of wounds[AI0228].

Sri Lanka. Hot water extract of the entire plant is used externally for wounds and ulcers, skin diseases, leprosy and rheumatic disorders. The extract is taken orally for fevers, malaria, jaundice, and syphilis[AI0359].

Thailand. Extract of the dried flower is taken orally as a bitter tonic[AI0272]. Hot water extract of the dried fruit is taken orally as an anthelmintic, laxative, bitter tonic and for fever[AI0270,AI0272]. The dried unripe fruit is taken orally as a bitter tonic and for fever[AI0272] and the dried gum is used as a bitter tonic[AI0272].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Alanine: Fl[AI0216]
Phenylalanine: Sd[AI0207]
Androsta-1-14-dien-3-16-dione, 7-alpha-acetoxy-4-4-8-trimethyl-5-alpha-17-oxa: Fr Pe 1.7[AI0159]

Arginine: Fl[AI0216], Call Tiss[AI0207]
Asparagine: Fl[AI0216]
Asparatic acid: Fl[AI0216]
Astragalin: Fl [AI0399], Lf 19.2[AI0225]
Azadirachta arabinoglactan: Fr Pu[AI0164]
Azadirachta indica glycoprotein: Gum[AI0262]
Azadirachta indica meliacin 1: Sd[AI0282]
Azadirachta indica meliacin 2: Sd[AI0282]
Azadirachta indica meliacin 3: Sd[AI0282]
Azadirachta indica meliacin 4: Sd[AI0282]
Azadirachta indica polysaccharide N-9-G1: Bk[AI0124]
Azadirachta indica polysaccharide N-9-G1A: Bk[AI0305]
Azadirachta indica polysaccharide N-9-G1B: Bk[AI0305]
Azadirachta polymer NB-1: St Bk[AI0229]
Azadirachta polymer NB-II: St Bk[AI0229]
Azadirachtanin; Lf 18.7[AI0119]
Azadirachtin: Sd 56.0-243.2[AI0211,AI0212]
Azadirachtin A: Sd oil 40.0[AI0169]
Azadirachtin B: Sd oil 13.7[AI0169]
Azadirachtin C: Sd oil[AI0203]
Azadirachtin D: Sd oil 5.2[AI0169]
Azadirachtin H: Sd oil 2.5[AI0169]
Azadirachtin I: Sd oil 0.75[AI0169]
Azadirachtin,12-nor,11-alpha-hydroxy: Sd 0.5[AI0163]
Azadirachtin, 3-acetyl-11-methoxy-1-tigloyl: Bk 8.0[AI0133]
Azadirachtin, 22-23-dihydro, 23-beta-methoxy: Sd 47.2[AI0133]
Azadirachtin, 3-deacetyl, cinnamoyl: Lf 4.6[AI0133]
Azadirachtinol, deacetyl: Fr oil 16.7[AI0117]
Azadirachtol: Fr 25[AI0118]
Azadirachtol, 3-tigloyl: Sd 5.6[AI0133]
Azadiractin K: Sd 30[AI0162]
Azadiradione: Sd 0.47%[AI0259],Fr 0.70%[AI0200]
Azadiradione,1-2-dihydro, epoxy-1-alpha-methoxy: Sd 30[AI0259]
Azadiradione,1-beta-2-beta-diepoxy: Sd 30[AI0259]
Azadiradione, 17-beta-hydroxy: Fr 0.015%[AI0200], Sd 0.035%[AI0259]
Azadiradione, 17-epi: Fr 35[AI0200], Sd 50[AI0259]
Azadiradione, 17-hydroxy: Fr[AI0279], Sd[AI0175]
Azadiradione, 7-deacetyl-17-beta-hydroxy: Sd[AI0135]
Azadiradione,7-deacetyl-7-benzoyl-epoxy: Sd 120[AI0259]
Azadiradione, 7-deacetyl-7-benzoyl: Sd 70[AI0259]
Azadiradione, defurano: Fr Pe 4.2[AI0159]
Azadiradione, epoxy: Fr 0.13%[AI0249], Sd 0.72%[AI0259]
Azadirinin: Rt Bk 2.8[AI0156]
Azadirol: Fr 20[AI0250]
Azadirolide, Iso: Lf [AI0125]
Azadirone: Fr Pe[AI0166], Sd 0.05%[AI0259]
Azadirone, 6-hydroxy: Lf [AI0133]
Azadirone, A-homo,1-2-dihydro,11-acetyl-4-alpha-6-alpha-dihydroxy: Lf [AI0133]
Azadirone, A-homo, 4-alpha-6-alpha-dihydroxy: Lf 11.4[AI0304]
Methyl butyl disulfide: Sd[AI0221]
N-propyl butyl disulfide: Sd[AI0221]
Prop-1-enyl butyl disulfide: Sd[AI0221]
Gamma amino butyric acid: Fl[AI0216]
Catechin: St Bk[AI0246]
Epi-gallo catechin: St Bk[AI0246]
Epi-catechin (-): St Bk[AI0246]
Gallo catechin: St Bk[AI0246]
Chlorogenic acid: Sd, Lf [AI0320]
Cholesterol: Fr[AI0122]
Iso-coumarin, 6-8-dihydroxy-3-methyl-3-4-dihydro: Twig[AI0219]
Iso- coumarin, 7-8-dihydroxy-3-methyl-3-4-dihydro: Twig[AI0219]
Cycloartanol, 24-methylene: Heartwood 0.01%[AI0196]
Cycloeucalenol: Trunkwood[AI0388]
Cysteine: Fl[AI0216]
Daucosterol: Heartwood 40[AI0196]
Di-n-propyl disulfide: Sd[AI0209]
Disulfide, cis-1-propenyl-1-propyl: Sd[AI0248]
Dipropyl disulfide: Sd[AI0248]
Trans-1-propenyl-1-propyl disulfide: Sd[AI0248]
N-docosane: Fr[AI0155]
N-docosene: Fr[AI0155]
Ergosta-8-24(28)-dien-3-beta-ol, 5-alpha-4-14-alpha-dimethyl: Heartwood[AI0196]
Ergosta-8-24(28)-dien-3-beta-ol, 5-alpha, 4-alpha-methyl: Heartwood[AI0196]
Fatty acids: Sd[AI0387]
Flavanone, 8-prenyl-5-7-dihydroxy-3'-(3-hydroxy-3-3-dimethyl-butyl)-4'-methoxy: Lf [AI0161]
Iso-fraxidin: Twig[AI0219]
5-hydroxy-methyl furfural: Fr 0.69%[AI0210]
Gallic acid: Stembark[AI0246]

Gazadirone: Sd 0.4%[AI0259]
Gedunin: Bk[AI0227], Fr[AI0122], Fl[AI0216], Sd 0.067%[AI0259]
7-deacetoxy-7-alpha-hydroxy gedunin: Sd[AI0393]
7-deacetoxy-7-benzoyl gedunin: Sd 0.015%[AI0259]
Deacetyl gedunin: Sd[AI0175]
Glutamine: Fl[AI0216]
Glycine: Fl[AI0216]
Glycopeptide: Gum[AI0274]
Glycoprotein: Gum[AI0287]
Grevillic acid methyl ester: Stembark 2.8[AI0140]
Hyperoside: Fl[AI0399], Lf[AI0264]
N-icosane: Fr[AI0155]
Kaempferol: Fl[AI0385]
Kaempferol-3-0-rutinoside: Lf 42[AI0225]
Kulactone: Fr 1[AI0250]
Iso-limbolide: Twig[AI0131]
Limbonin: Sd[AI0157]
Limocin A: Fr 3.3[AI0249]
Limocin B: Fr 3.3[AI0249]
Limocinin: Fr 5[AI0249]
Limocinol: Fr 1.6[AI0249]
Limocinone: Fr 2[AI0249]
Linoleic acid: Sd 15%[AI0113]
Lophenol, 24-methylene: Heartwood 0.015%[AI0213]
Lysine: Fl[AI0216]
Mahmoodin: Sd 50[AI0155]
Margocetin: Twig[AI0219]
Margocillin: Rt Bk[AI0147]
Margocinin: Rt Bk[AI0147]
Margolonone: St Bk 25[AI0142]
Margolonone, iso: St Bk 7.5[AI0142]
Margosin: Rt Bk[AI0147]
Margosine: St Bk 7.0[AI0149]
Margosinolide: Twig 4.2[AI0126]
Margosinolide, iso: Twig 8.3[AI0126]
Margosinolone: St Bk 3.2[AI0150]
Margosinone: St Bk 8.5[AI0150]
Margosolone: St Bk 4.7[AI0149]
Meldenin: Sd 5[AI0103], Lf[AI0206]
Meldenin, iso: Lf[AI0206]
Meldenin-1-ene-6-7-diol: Lf[AI0206]
Melia azadirachta polysaccharide GI-A: Bk 0.037%[AI0292]
Melia azadirachta polysaccharide GI-B: Bk 0.037%[AI0292]
Melia azadirachta polysaccharide N-9-G-I: Sd[AI0338]
Melia lactone I: Sd oil[AI0103]
Melia lactone II: Sd oil[AI0103]
Melia polysaccharide CSP-I: Bk[AI0171,AI0254]
Melia polysaccharide CSP-II: Bk[AI0233,AI0254]
Melia polysaccharide CSP-III: Bk[AI0233,AI0171,AI0254]
Melia polysaccharide CSSP-I: Bk[AI0233]
Melia polysaccharide CSSP-II: Bk[AI0233]
Melia polysaccharide CSSP-III: Bk[AI0233]
Melia polysaccharide FG-III-C: Bk[AI0160]
Melia polysaccharide G-II-A: Bk[AI0160]
Melia polysaccharide G-III-B: Bk[AI0160]
Melia polysaccharide N-9-GI: Bk[AI0153,AI0154]
Melia polysaccharide N-9-GI-A: Bk[AI0153]
Melia polysaccharide N-9-GI-B: Bk[AI0153]
Meliacarpin, 1-3-diacetyl-11-19-deoxa-11-oxo: Sd 0.8[AI0141]
Meliacarpin, 3-acetyl-11-hydroxy-4-beta-beta-methyl-1-tigloyl: Sd 0.5[AI0158]
Meliantriol: Sd[AI0394]
Melicitrin: Fl[AI0399]
Mellein, 6-methoxy: Twig[AI0219]
Myricetin: Fl[AI0112]
Myricetin-3-0-rutinoside: Lf 25.6[AI0225]
Naheedin: Fr 3[AI0155]
Neotrichilenone, 7-acetyl: Sd 70[AI0259]
Nimbadiol: Sd[AI0175]
Nimbaflavone: Lf 18.8[AI0307,AI0202]
Nimbanal: Sd 139[AI0139]
Nimbandiol: Lf 130, Sd oil 250[AI0261]
Nimbandiol, 6-0-acetyl: Sd oil 120[AI0261], Fr oil 93.3[AI0117]
Nimbidin: St Bk[AI0313], Sd oil 1.1%[AI0309,AI0199]
Nimbidinin: Ker[AI0404]
Nimbidiol: Rt Bk 100[AI0130]
Nimbidol: Sd[AI0100]
Nimbilicin: Rt Bk 0.25[AI0144]
Nimbilin: Rt Bk 2.3[AI0146]
Nimbin: Lf[AI0148], Call Tiss[AI0268], Sd oil 0.19%[AI0102], Bk 800[AI0402], Fl[AI0216], Ker 210[AI0162]
Nimbin, 4-epi: Sd oil 0.25%[AI0165]
Nimbin, 6-deacetyl: Lf[AI0148]
Nimbin, 6-deacyl: Sd 200[AI0162]
Nimbin, acetyl: Tr Bk, Twig[AI0127], Sd[AI0395]
Nimbal, 6-deacetyl: Lf 120[AI0148]
Nimbinene: Lf 30, Bk 300, Sd oil 40[AI0261]
Nimbinene, 6-deacetyl: Lf 60, Bk 38, Sd oil 52[AI0261]

Nimbinin: Sd[AI0401,AI0103]
Nimbinol: Sd 0.8[AI0148]
Nimbinolide, deacetyl: Twig 1.7[AI0127,AI0131]
Nimbinolide, iso: St Bk[AI0134]
Iso-nimbinolide, deacetyl: Twig 2.5[AI0127,AI0131]
Nimbinone: St Bk[AI0134]
Nimbiol: Tr Bk 110[AI0397,AI0399]
Methyl nimbiol: St Bk 3.3[AI0136]
Nimbione: St Bk[AI0134]
Nimbionol: St Bk 22.9[AI0138]
Demethyl nimbionol: St Bk 0.4[AI0151]
Nimbionone: St Bk1529[AI0138]
Methyl nimbionone: St Bk 7.3[AI0136]
Nimbisonol: St Bk 0.3[AI0151]
Nimbocetin: Fr 200[AI0210]
Nimbochalcin: Fr 150[AI0210]
Nimbocidin: Rt Bk 0.3[AI0144]
Nimbocinol: Fr 0.10%[AI0122], Sd oil 0.12%[AI0152]
Nimbocinol, 17-epi: Sd oil 880[AI0152]
Nimbocinolide: Lf 9.5[AI0137]
Nimbocinolide, iso: Lf[AI0120]
Nimbocinone: Lf 250[AI0123]
Nimbolicin: Rt 0.58[AI0143]
Nimbolide: Lf 13.3-400[AI0145,AI0148], Sd 13[AI0162]
Nimbolide, 28-deoxo: Lf 60-199[AI0148,AI0145]
Nimbolin A: Wood[AI0403]
Nimbolin B: Wood, Rt 19.7[AI0143]
Nimbonolone: St Bk 2.3[AI0140]
Nimbonone: St Bk 7.6[AI0140]
Nimbosodione: St Bk 0.6[AI0151]
Nimbosone: St Bk 3.2[AI0136]
Nimocin: Lf 0.5[AI0121]
Nimocinol: Lf[AI0123,AI0201]
Nimocinolide: Lf 4-17[AI0121,AI0137]
Nimocinolide, iso: Twig[AI0131], Lf 32[AI0121]
Nimolicinoic acid: Fr 0.4[AI0129]
Nimolicinol: Fr 50[AI0269]
Nimolicinolide, iso: Fr 1.0[AI0129]
Nimolide, iso: Twig[AI0131]
Nimolinin: Rt Bk 0.14[AI0146]
Nimolinone: Fr[AI0132]
Nimosone: St Bk 8.5[AI0136]
Nimbin: Pl[AI0207]
Nonan-2-one: Sd[AI0221]
Onchinolide B: Ker 73[AI0162]
Oleic acid: Heartwood[AI0196], Sd oil 49%[AI0113]
Ornithine: Pl, Call Tiss[AI0207]
Palmitic acid: Heartwood[AI0196], Sd oil 15%[AI0113]
Pent-2-enal, 2-methyl: Sd[AI0221,AI0248]
Polysaccharide CSP-I: Bk[AI0215]
Polysaccharide CSP-II: Bk[AI0215]
Polysaccharide CSP-III: Bk[AI0215]
Polysaccharide G-III-D0′-2-I-A: Bk 16.1[AI0312]
Polysaccharide G-III-D0′-2-I-B: Bk 13.2[AI0312]
Polysaccharide G-III-D0′-2-II-A: Bk 16.3[AI0312]
Polysaccharide G-III-D0′-2-II-B: Bk 11.0[AI0312]
Polysaccharide MA-9: Bk[AI0239]
Polysaccharide N-9-GI (Azadirachta indica): Bk 144[AI0116]
Proline: Pl[AI0207]
Prop-I-cis-enyl tetrasulfide, n-propyl: Sd[AI0221]
Prop-I-cis-enyl trisulfide, di: Sd[AI0221]
Prop-I-cis-enyl trisulfide, methyl: Sd[AI0221]
Prop-I-cis-enyl trisulfide, n-propyl: Sd[AI0221]
Prop-I-enyl disulfide, methyl: Sd[AI0221]
Prop-I-trans-enyl trisulfide, n-propyl: Sd[AI0221]
Prop-I-trans-enyl disulfide, n-propyl: Sd[AI0221]
Prop-I-trans-enyl tetrasulfide, n-propyl: Sd[AI0221]
Prop-I-trans-enyl trisulfide, di: Sd[AI0221]
Prop-I-trans-enyl trisulfide, methyl: Sd[AI0221]
Prop-2-enyl trisulfide, n-propyl: Sd[AI0221]
Propyl disulfide, di: Sd[AI0221]
Propyl disulfide, methyl: Sd[AI0221]
Propyl tetrasulfide, di: Sd[AI0221]
Propyl trisulfide, di: Sd[AI0221]
Propyl tetrasulfide, methyl: Sd[AI0221]
Protein: Lf 13.42%[AI0386,AI0314]
Quercetin: Lf 0.257%[AI0206], Fl[AI0112]
Quercetin-rhamnoside: Lf 0.45%[AI0210]
Quercitrin: Lf 4.8[AI0225,AI0264]
Quercitrin, iso: Lf 37.2[AI0225]
Rhamnetin, iso: Lf[AI0210]
Rutin: Lf 132[AI0225]
Salannin: Sd oil 0.95%[AI0102]
Salannin, 3-deacetyl: Lf 31.3[AI0307], Fr fixed oil 183[AI0117]
Salannin, deacetyl: Sd oil[AI0175]
Salannol: Sd oil[AI0289]
Salannol, 2′-3′-dehydro: Lf 31.9[AI0202]

Salannol, 3-0-acetyl: Sd 222[AI0139]
Salannolactam 21: Ker 25[AI0128]
Salannolactam 23: Ker 8.3[AI0128]
Salannolide: Sd[AI0306]
Scopoletin: Twig[AI0219], Lf[AI0125]
Serine: Sd, Pl[AI0207]
Sitosterol, beta: Heartwood 0.15%[AI0196], Tr Bk 40[AI0397], Lf[AI0385,AI0202], Fl[AI0216]
Stearic acid: Sd oil 15%[AI0113]
Stigmasterol: Lf[AI0123]
Sugiol: Tr Bk 70[AI0397]
Tannin: St Bk 15.8%[AI0303], Tr Bk 15.0%[AI0396]
Thiophene, 2-4-dimethyl: Sd[AI0248,AI0221]
Thiophene, 3-4-dimethyl: Sd[AI0221,AI0248]
Threonine: Fl[AI0216], Pl, Call tiss[AI0207]
Tiglic acid: Sd oil 200[AI0114]
Tricosane, 2-methyl: Fr[AI0155]
Trithiolane, 1-2-4, cis-3-5-diethyl: Sd[AI0248]
Trithiolane, 1-2-4, trans-3-5-diethyl: Sd[AI0248]
Tryptophan: Pl[AI0207]
Tyrosine: Pl, Call Tiss, Sd[AI0207]
Undecan-2-one: Sd[AI0221]
Valine: Pl[AI0207]
Valine, nor: Fl[AI0216]
Velpinin: Sd oil[AI0401]
Vepaol: Sd[AI0323]
Vilasinin: Lf[AI0392]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient activity. The dried fixed oil, when administered intraperitoneally to rats, was 100% effective[AI0362]. Ethanol/water (1:1) extract of the dried seed, administered orally to pregnant rats at a dose of 100.0 mg/kg, was inactive[AI0284]. The seed oil, administered intravaginally to pregnant rats at doses of 0.25 ml/animal[AI0373] and 12.5 microliters/animal[AI0316], was active.

Acid phosphatase inhibition. The dried leaf, administered intragastrically to rats at a dose of 1.0 gm/kg, was active vs paracetamol-induced hepatotoxicity[AI0184].

Alkaline phosphatase inhibition. The dried leaf, administered intragastrically to rats at a dose of 1.0 gm/kg, was active vs paracetamol-induced hepatotoxicity[AI0184].

Alkaline phosphatase stimulation. The dried leaf, in the ration of chicken at a dose of 2.0% of the diet, was active[AI0255].

Analgesic activity. Ethanol (95%) extract of the dried leaf, administered intragastrically to female mice at a dose of 100.0 mg/kg, was active vs acetic acid-induced writhing. A dose of 1 gm/kg was inactive in the male vs tail clip method. At a dose of 300.0 mg/kg, the extract was active vs subcutaneous injection of Brewer's yeast[AI0258]. Ethanol (50%) extract of the stemwood, administered intragastrically to mice, was inactive vs hot plate and tail clip methods[AI0379]. Ethanol/water (50%) extract of the dried root, stemwood, fruit pulp and root wood, administered intragastrically to mice, was inactive vs hot plate and tail clip methods[AI0379]. Hot water extract of the dried leaf, administered by gastric intubation to male mice at a dose of 100.0 mg/kg, was inactive vs hot plate method and inhibition of acetic acid-induced writhing[AI0293].

Anthelmintic activity. A mixture of equal parts of *Butea frondosa*, *Moringa pterygosperma*, *Piper nigrum*, *Azadirachta indica* and *Embelia ribes* was taken orally by adults of both sexes, at a dose of 1–2.0 gm/person with dosing 3 times daily for 4–8 weeks. The results indicated that the treatment was positive on 11 cases of ascariasis, 9 cases of ancylostomiasis, 9 cases of enterobiasis and 7 cases of *Hymenolepis nana*. Stool specimens were found negative at the end of the treatment period[AI0280].

Antiancylostomiasis activity. The essential oil, taken orally by adults at a dose of 10.0 ml/person, was inactive in 17 patients[AI0389]. The leaf juice, taken orally by adults at a dose of 20.0 ml/person, was inactive in 12 patients[AI0389].

Antiandrogenic effect. The dried leaf, administered intragastrically to male rats at a dose of 20–60 mg/animal, was equivocal[AI0380].

Antiarrhythmic activity. Hot water extract of the leaf, administered intravenously to

rabbits of both sexes at a dose of 40.0 mg/kg, was active[AI0198].

Antiascariasis activity. Ethanol (95%) extract of the seed produced paralysis in earthworms. Eighteen hours after treatment no death was observed[AI0167].

Antibacterial activity. Acetone extract of the oven-dried leaf, on agar plate, was active on *Escherichia coli*, *Klebsiella pneumoniae*, *Neisseria gonorrhea*, *Proteus vulgaris*, *Psuedomonas aeruginosa*, *Salmonella typhimurium* Type 2, *Shigella dysenteriae*, *Staphylococcus aureus*, *Streptococcus faecalis*, and *Vibrio cholera*[AI0367]. Chromatographic fraction of the stembark, on agar plate, was active on *Bacillus subtilis*, *Staphylococcus epidermidis* and *Klebsiella* species, and produced weak activity on *Staphylococcus citreus* and *Streptococcus lactis*[AI0138]. Ethanol (95%) extract of the dried seed and seed oil, on agar plate, were active on several gram positive and gram negative organisms[AI0267]. Ethanol (95%) extract of the dried seed, at a concentration of 1.0%, prevented the spread of bacterial wilt to cantaloupe plants[AI0295]. Methanol extract of the dried leaf, at a concentration of 2.0 mg/ml on agar plate, was active on *Proteus vulgaris*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*, and inactive on *Corynebacterium diphtheriae*, *Neisseria* species, *Salmonella* species, *Streptobacillus* species and *Streptococcus* species[AI0252]. The seed oil, at a concentration of 0.3% on agar plate, was active on *Staphylococcus aureus* and 0.4% was active on *Salmonella typhosa*. The undiluted seed oil was active on *Bacillus subtilis*, 15 mm zone of inhibition; *Corynebacterium diphtheriae*, 14 mm zone of inhibition; *Escherichia coli*, 15 mm zone of inhibition; *Salmonella paratyphi* A, 15 mm zone of inhibition; *Salmonella paratyphi* B, 20 mm zone of inhibition; *Salmonella typhosa*, 16 mm zone of inhibition; *Staphylococcus albus*, 15 mm zone of inhibition and *Staphylococcus aureus*, 20 mm zone of inhibition. The seed oil was inactive on *Pseudomonas aeruginosa*[AI0384]. The seed oil, at a concentration of 3.0% on agar plate, was active on *Escherichia coli* and *Proteus* species; a concentration of 6.0% was active on *Klebsiella pneumoniae*[AI0351]. The seed oil, administered intravaginally to adults at a dose of 5.0 ml/day for 2 weeks, was active in a double-blind, placebo-controlled study on 55 patients with abnormal vaginal discharge due to microbial infections vs bacterial vaginosis. The treatment was also active on *Chlamydia trachomatis*[AI0194]. Water extract of the dried leaf, on agar plate, was active on *Actinomycete* species and other bacterial species. Commercial dentifrices were tested alone and in combination with plant extracts against plaque bacteria in the paper disc assay. The addition of the plant extract significantly increased the zone of inhibition relative to that of the dentifrices. The extract was active on *Bacteroides gingivalis* vs 2 clinical isolates; *Pseudomonas saccharophila* vs clinical isolate; *Streptococcus salivarius* vs 5 clinical isolates and *Streptococcus viridans* vs 40 clinical isolates. The extract was active when taken orally by adults. Fifty patients with chronic suppurative periodontitis were given the leaf extracts of *Mangifera indica*, *Camellia sinensis*, *Murraya koenigii*, *Ocimum basilicum* or *Azadirachta indica*. The bacterial population declined by 50%, and 40 patients showed improvement[AI0223].

Anticholinergic activity. Hot water extract of the dried leaf, administered by gastric intubation to male mice at a dose of 500.0 mg/kg, was inactive[AI0293]. Methanol extract and methanol insoluble fractions of the dried leaf, in cell culture at variable dosage levels, were inactive on the ileum[AI0240].

Anticomplement activity. Water extract of the dried bark was active on human blood[AI0372]. Water extract of the dried stembark, at a concentration of 1.0 mg/ml, was active[AI0356].

Anticonvulsant activity. Ethanol (95%) extract of the dried leaf, administered intra-

gastrically to mice at a dose of 1.0 gm/kg, was inactive vs electrically-induced convulsions[AI0258]. The hot water extract, administered by gastric intubation to male mice at a dose of 500.0 mg/kg, was inactive vs strychnine-, metrazole- and supramaximal electroshock-induced convulsions[AI0293].

Anticrustacean activity. Chloroform, ethanol (100%) and water extracts of the dried leaf and stem were active on *Artemia salina*. The assay system was intended to predict for antitumor activity[AI0186].

Antiestrogenic effect. The seed oil, administered subcutaneously to rats at doses of 0.2 ml/animal[AI0222] and 0.3 ml/animal[AI0363], was inactive.

Antifertility activity. The volatile component of neem oil, administered intravaginally to rabbits at a dose of 10.0 mg/animal, was active[AI0378]. The seed oil, administered by gastric intubation to male rats at doses of 2.0 and 4.0 ml/kg, was inactive. A dose of 6.0 ml/kg was equivocal[AI0310]. A dose of 1.0 ml/animal administered intravaginally to humans and to Rhesus monkeys prior to intercourse was 100% effective. The intravaginal dose of 20.0 microliters/animal was active in the rabbit[AI0301]. Water extract of the fresh leaf, administered by gastric intubation to male mice at a dose of 1.0 ml/animal, was active. The extract was obtained from 0.5 gm of fresh leaf equivalent per 1.0 ml. Dosing was done daily for 1 month, followed by mating. Results significant at $P < 0.05$ level[AI0290]. When the water and hot water extracts of the fresh leaf were administered orally to male mice daily for 6 weeks before mating, the activity was reversible without inhibition of spermatogenesis. The cause was apparently an antimating effect[AI0281].

Antifilarial activity. Hot water extract of a commercial preparation containing *Melia azadirachta* (15%), *Sida cordifolia* (15%), *Tribulus terrestris* (12%), *Terminalia chebula* (39%) *and Tinospora cordifolia* (19%), at a dose of 100.0 mcg/ml, produced weak activity. A dose of 500.0 mcg/ml was active on *Acanthocheilonema viteae*[AI0236]. The fresh leaf was active on *Setaria digitata*, LC_{100} 82,000 ppm[AI0242].

Antifungal activity. Acetone extract of the oven-dried leaf, on agar plate, was inactive on *Aspergillus fumigatus*, *Epidermophyton floccosum*, *Microsporum canis*, *Microsporum gypseum*, *Trichophyton mentagrophytes* and *Trichophyton rubrum*[AI0367]. The aqueous, low-speed supernatant of the fresh leaf, in broth culture at a concentration of 100.0 ml/liter, was inactive on *Hendersonula toruloidea*[AI0319]. Water extract of the fresh leaf, on agar plate at a concentration of 50%, was active on *Fusarium oxysporum* F. Sp. Lentis. The extract represented 1 gm of dried leaf in 1.0 ml of water[AI0190]. Butyl-methyl-ether and methanol extracts of the dried kernel, on agar plate, were active on *Epidermophyton floccosum*, *Microsporum canis*, *Microsporum gypseum*, *Trichophyton concentricum*, *Trichophyton mentagrophytes*, *Trichophyton rubrum* and *Trichophyton violaceum*. The chloroform extract was active on *Epidermophyton floccosum*, *Microsporum canis*, *Microsporum gypseum*, *Trichophyton concentricum*, and *Trichophyton mentagrophytes*; inactive on *Trichophyton rubrum* and produced strong activity on *Trichophyton violaceum*[AI0234]. Butyl-methyl-ether extract of the dried leaf, on agar plate, was active on *Epidermophyton floccosum*, *Microsporum canis*, M. *gypseum*, *Trichophyton concentricum*, and T. *violaceum*, and was inactive on T. *mentagrophytes* and T. *rubrum*. Ethanol (70%) extract, when applied externally on 7 patients with ringworm at a concentration of 40.0% twice daily for 5–10 days, was active[AI0283]. Ethanol (50%) extract was active on *Rhizoctonia solani*, mycelial growth was inhibited 32.5%[AI0375]. The hot water extract, in broth culture, was active on *Trichophyton mentagrophytes*[AI0226]. Methanol extract, on agar plate, was active on *Epidermophyton flocco-*

sum, *Microsporum canis*, *Microsporum gypseum*, *Trichophyton mentagrophytes*, *Trichophyton rubrum* and *Trichophyton violaceum*, and was inactive on *Trichophyton concentricum*. Petroleum ether extract, on agar plate, was active on *Microsporum canis*, *Microsporum gypseum*, *Trichophyton concentricum*, *Trichophyton mentagrophytes* and *Trichophyton rubrum*, and produced strong activity on *Trichophyton violaceum*[AI0234]. Essential oil of the fresh leaf, in broth culture, was active on *Trichophyton mentagrophytes*, MIC 125.0 mcg/ml[AI0214]. Hot water extract of the dried stem, in broth culture, was active on *Trichophyton mentagrophytes*[AI0226]. The seed oil, at a concentration of 1.4%, was active on *Diaporthe citri*[AI0256]. Water extract of the fresh fruit, at a concentration of 20.0%, was active on *Trichoconiella padwickii*[AI0224].

Antihistamine activity. Methanol extract and methanol-insoluble fraction of the dried leaf, in cell culture at variable concentrations, was inactive on the ileum[AI0240].

Antihyperglycemic activity. A mixture containing *Gymnema sylvestre*, *Syzygium cumini*, *Azadirachta indica* and *Enicostema hyssopifolium*, administered intragastrically to rats at a dose of 40.0 mg/kg, was active vs anterior pituitary extract-induced hyperglycemia[AI0115]. Ethanol (95%) extract of the dried leaf, administered intraperitoneally to rats at doses of 500.0 mg/kg[AI0225] and 75.0 mg/animal[AI0350], were active vs streptozotocin-induced hyperglycemia. The hot water extract, administered by gastric intubation to rabbits at variable dosage levels, was inactive[AI0291]. Hot water extract of the dried leaf, administered by gastric intubation to mice at a dose of 0.5 ml/animal (a concentration of 25% of the extract), produced weak activity vs alloxan-induced hyperglycemia[AI0325]. The seed oil, administered by gastric intubation to rabbits at a dose of 2.5 ml/kg, was active[AI0291]. A dose of 200.0 mg/animal was active in rats vs alloxan-induced hyperglycemia. Results significant at P <0.01 level[AI0342]. A dose of 21.0 mg/kg was active in the rat[AI0344]. Water extract of the fresh leaf, administered intragastrically to rats, was active vs epinephrine- and streptozotocin-induced hyperglycemia and vs glucose-loaded animals[AI0187]. Hot water extract of the dried leaf, administered intravenously to dogs at a dose of 0.15 mg/kg, was active vs epinephrine-induced hyperglycemia. The extract was prepared by boiling 100 gm of fresh tender leaves with 200.0 ml of distilled water for 2 hours[AI0273].

Antiimplantation effect. Decoction of the volatile component of neem oil, administered intrauterine to pregnant rats at a dose of 1.0 mg/animal, was active. The essential oil, administered intravaginally to rabbits and pregnant rats at a dose of 10.0 mg/ml, was inactive[AI0378]. The essential oil, administered orally to the rat at a dose of 4.0 ml/kg on days 1–3, was also active[AI0354]. The seed oil, administered by gastric intubation at a dose of 5.0 ml/animal, was inactive[AI0364]. A subcutaneous dose of 0.2 ml/animal and intravaginal administration to pregnant rats at a dose of 12.5 ml/animal, was active[AI0316]. Ethanol/water (1:1) extract of the dried seed, administered orally to female rats at a dose of 100.0 mg/kg, was inactive[AI0284].

Antiinflammatory activity. Chloroform extract of the fresh stembark, applied externally to rats at a dose of 1.0%, was active vs croton oil-induced inflammation of the ear. The extract, when administered intragastrically to rats at a dose of 1.0 gm/kg, was active vs carrageenin-induced pedal edema[AI0284]. Ethanol (70%) extract of fresh bark and leaf, administered by gastric intubation to rats at a dose of 400.0 mg/kg, was active vs carrageenin-induced pedal edema[AI0260]. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 1.0 gm/kg, was active vs carrageenin-induced pedal edema[AI0258]. The gum, taken orally by adults of both sexes at variable dosage levels, was active[AI0298]. The

seed oil, administered intramuscularly to the rat at a dose of 50.0 mg/kg, was active vs cotton pellet granuloma[AI0275].

Antimalarial activity. Acetone/water (1:1) extracts of the dried bark, dried root and dried leaf, on agar plate at a concentration of 20.0 microgram/ml, were active on *Plasmodium falciparum*[AI0182]. The water extract, when administered orally to mice at a dose of 0.1 gm/kg, was active on *Plasmodium yoelii*[AI0355]. Ethanol (95%) extract of dried stembark, in broth culture, was inactive on *Plasmodium falciparum*[AI0232], but ethanol (95%) extract of the dried entire plant was active, ED_{50} 5.0 mcg/ml. When administered to mice subcutaneously at a dose of 31.0 mg/kg, and by gastric intubation at a dose of 62.5 mg/kg, the extract was inactive on *Plasmodium berghei*. The water extract was active on *Plasmodium falciparum*, ED_{50} 115.0 mcg/ml. When administered by gastric intubation to mice at a dose of 746 mg/kg, and subcutaneously at a dose of 93.0 mg/kg, the extract was inactive on *Plasmodium berghei*[AI0205]. Ethanol (95%) extract of the dried leaf at a concentration of 25.0 mcg/ml was active on *Plasmodium falciparum*[AI0368]. Ethanol (95%) extract of the dried leaf, in broth culture, was inactive on *Plasmodium falciparum*, IC_{50} 50.0 mcg/ml. The water, methanol and petroleum ether extracts, at a concentration of 500.0 mcg/ml, were inactive[AI0232]. Ethanol (95%) extract of the dried seed at a concentration of 200.0 mcg/ml was active on *Plasmodium falciparum*[AI0368]. Hot water extract of the fresh leaf, administered by gastric intubation to mice at a dose of 500.0 mg/kg on days 1–4, produced weak activity on *Plasmodium berghei*. There was some suppression of parasitemia. Water extract of the fresh leaf, at a concentration of 1.0 mg/ml, was inactive on guinea pig ileum, seminal vesicles and vas deferens, rabbit duodenum, and rat stomach (fundus) and seminal vesicle[AI0341]. Hot water extract of the leaf, administered orally to mice at a dose of 5.0 ml/animal, was inactive on *Plasmodium berghei*. One ml of the extract is equivalent to 1 gm of dried leaves. The animals were dosed once before infection and then once daily[AI0197]. Methanol and petroleum ether extracts of the dried leaf were inactive on *Plasmodium falciparum* vs hypoxanthine uptake by plasmodia, IC_{50} 499.0 mcg/ml[AI0241]. Methanol extract of the dried stembark was inactive on *Plasmodium falciparum* vs hypoxanthine uptake by plasmodia, IC_{50} >499 mcg/ml[AI0241]. Water extract of the bark, administered orally to chicken at a dose of 1.10 gm/kg, was inactive on *Plasmodium gallinaceum*[AI0101].

Antimitotic activity. Hot water extract of the dried leaf, at concentrations of 1.5% and 10.0%, was active on *Allium cepa* root tips[AI0276].

Antimycobacterial activity. Ethanol (95%) extract of the fresh leaf essential oil, on agar plate, was inactive on *Mycobacterium tuberculosis*[AI0383].

Antinematodal activity. Water extract of the dried leaf, at variable concentrations, produced strong activity on *Meloidogyne incognita*[AI0300].

Antiprogesterone effect. The seed oil, administered subcutaneously to rats at a dose of 0.3 ml/animal, was inactive[AI0363].

Antipyretic activity. Chloroform, water and hexane extracts of a commercial sample of the seed, administered orally to rabbits at a dose of 150.0 mg/kg, were inactive vs yeast-induced pyrexia[AI0357]. Chloroform, water and hexane extracts of the dried leaf and twig, administered by gastric intubation to rabbits at a dose of 150.0 mg/kg, were active vs yeast-induced pyrexia. Results significant at $P < 0.05$ level[AI0331]. Ethanol (70%) extract of the fresh leaf and bark, administered by gastric intubation to rabbits at a dose of 400.0 mg/kg, was active[AI0260]. The seed oil, administered subcutaneously to male rats at a dose of 50.0 mg/kg, was active vs yeast-induced fever[AI0100]. Water

extract of the dried fruit, administered by gastric intubation to rabbits at a dose of 600.0 gm/kg (dry weight of plant), was inactive vs yeast-induced pyrexia[AI0270].

Antischistosomal activity. Water extract of the dried leaf, at a concentration of 500.0 ppm, produced weak activity on *Schistosoma mansoni*[AI0245].

Antispasmodic activity. Ethanol/water (1:1) extract of the dried leaf, at variable concentrations, was active on guinea pig ileum[AI0406]. Ethanol/water (1:1) extract of the stembark was active on guinea pig ileum vs ACh- and histamine-induced spasms[AI0107].

Antispermatogenic effect. Ethanol (80%) extract of the dried leaf, administered intragastrically to male rats at a dose of 100.0 mg/kg daily for 21 days, was inactive[AI0377]. The dried leaf, administered intragastrically to male rats at a dose of 20–60 mg/animal daily for 24 days, was active[AI0380]. The seed oil, administered by gastric intubation to male rats at doses of 2.0, 4.0, and 6.0 ml/kg, was inactive[AI0310]. The intraluminal injection (into the vas deferens), at a dose of 50.0 mcg/animal, was active[AI0381].

Antitrichomonal activity. The seed oil, administered intravaginally to adults at a dose of 5.0 ml/day for 2 weeks, in a double-blind, placebo-controlled study on 55 patients with abnormal vaginal discharge due to microbial infections, was inactive on *Trichomonas vaginalis*[AI0194].

Antitumor activity. Polysaccharide fraction of the dried bark, administered intraperitoneally to mice at a dose of 25.0 mg/kg, was active on sarcoma 180 (solid). The biological activity has been patented[AI0336].

Antiulcer activity. Chloroform extract of the fresh stembark, at a dose of 1.0% applied to the rat ear simultaneously with croton oil, was active[AI0230]. The dried seed, taken orally by human adults at a dose of 100.0 mg/person twice daily, was found to completely cure chronic ulcers that were 1 cm deep, in 34 days. No side effects were observed[AI0311]. Water extract of the dried leaf, administered intragastrically to rats at a dose 160.0 mg/kg, and a dose of 100 mg/kg administered intraperitoneally, were active vs stress-induced ulcers (restraint). A dose of 40.0 mg/kg was active when the animals were pre-treated for 5 days[AI0179].

Antiviral activity. Ethanol/water (1:1) extract of the dried twig, in cell culture at a concentration of 0.05 mg/ml, was inactive on Ranikhet and Vaccinia viruses[AI0173]. Ethanol/water (1:1) extracts of the dried root, fruit pulp, leaf and root-wood, in cell culture at a concentration of 0.05 mg/ml, were inactive on Vaccinia virus[AI0379]. Hot water extract of the dried leaf, in cell culture at a concentration of 4.0 mg/ml, was inactive on Herpes Simplex 1 and 2 viruses, influenza virus (A-2/England/42/72), Japanese encephalitis virus, mumps virus, parainfluenza virus, Poliovirus 1, Sindbis virus, Chandipura virus and Dengue virus. It produced weak activity on Chikungunya virus, measles virus, Vaccinia virus and Nile virus[AI0168], and was active on Spinach Mosaic virus[AI0360]. Undiluted leaf juice was active on the Bean Mosaic virus[AI0315]. Water extract of the bark was active on Potato X virus[AI0104].

Antiyeast activity. Acetone extract of oven-dried leaf, on agar plate, was inactive on *Candida albicans*, *Cryptococcus neoformans*, *Histoplasma capsulatum* and *Sporotrichum schenckii*[AI0367]. The seed oil was administered intravaginally to 55 adult patients with abnormal vaginal discharge due to microbial infections, at a dose of 5.0 ml/day for 2 weeks, in a double-blind, placebo-controlled study. The extract was inactive on *Candida albicans*[AI0194]. The seed, on agar plate at a concentration of 1.0%, was active on *Cryptococcus neoformans*[AI0400].

Barbiturate potentiation. Hot water extract of the dried leaf, administered by gas-

tric intubation to male mice at a dose of 500.0 mg/kg, was inactive[AI0293]. Methanol extract and the methanol-insoluble fraction of the dried leaf, administered orally to mice at a dose of 100.0 mg/kg, were active[AI0240].

Bitter tasting effect. Ethanol (60%) extract of dried stembark, taken orally by human adults at a dose of 0.03 gm/person, was active. The 10% ethanol extract was 3 times bitterer than genetian. The tincture was presented in a mixture composed of iron and ammonium citrate (7.2 gm), tincture of crude drug (2.4 ml), syrup of orange (4.0 ml) and peppermint water, to a total volume of 60.0 ml. It was given at a dose of 0.13 ml/person and was reported to be a little bitter and had an iron taste[AI0272].

Cardiotoxic activity. Ethanol/water (1:1) extract of the dried leaf, administered intravenously to dogs at variable dosage levels, was inactive[AI0406].

Cellular immunity stimulation. The seed oil, administered intraperitoneally to mice at a dose of 150.0 microliters/animal, was active. The response to tetanus toxoid was assayed[AI0172].

Clastogenic activity. Water extract of the dried entire plant was active on *Foeniculum vulgare* somatic cells[AI0370].

CNS depressant activity. Methanol extract and the methanol-insoluble fraction of the dried leaf, administered orally to mice at a dose of 100.0 mg/kg, were active[AI0240].

Complement alternative pathway inhibition. A decoction consisting of the dried barks of *Azadirachta indica*, *Terminalia cheruba*, *Terminalia bellerica*, *Woodfordia floribunda*, and *Phyllanthus emblica*, in cell culture, was active on polymorphonuclear leukocytes[AI0174].

Complement classical pathway inhibition. A decoction consisting of the dried barks of *Azadirachta indica*, *Terminalia cheruba*, *Terminalia bellerica*, *Woodfordia floribunda*, and *Phyllanthus emblica*, in cell culture, was active on polymorphonuclear leukocytes[AI0174].

Cytotoxic activity. Chloroform extract of the fruit and leaf, in cell culture, was active on CA-9KB, ED_{50} <20.0 mcg/ml[AI0407]. Ethanol/water (1:1) extract of the stembark, in cell culture, was inactive on CA-9KB, ED_{50} >20.0 mcg/ml[AI0107]. Methanol extract of the dried bark, administered intraperitoneally to mice at a dose of 100.0 mg/kg on days 1-4, was active on sarcoma 180 (ASC) [AI0337]. The polysaccharide fraction of the dried bark, in cell culture, was active on sarcoma (unspecified). The biological activity has been patented[AI0171].

Dermatitis producing effect. Dried leaf, applied as patch test to a 50 year-old patient with recurrent contact dermatitis, was active[AI0243]. The fresh leaf, when applied externally on adults, was active vs patch test. Of the 207 patients tested, 5.45% were sensitive[AI0358].

Diuretic activity. Ethanol/water (1:1) extracts of the seedling root, stemwood and root-wood, administered intragastrically to rats at a dose of 510.7 mg/kg, were inactive[AI0379]. Ethanol/water (1:1) extracts of the dried root, fruit pulp and leaf, administered intragastrically to rats at a dose of 510.7 mg/kg, were active[AI0379]. Methanol extract and the methanol-insoluble fraction of the dried leaf, administered orally to mice at a dose of 50.0 mg/kg, were inactive[AI0240].

Embryotoxic effect. Acetone and water/ethanol (1:1) extracts of the dried leaf, administered by gastric intubation to pregnant rats at a dose of 200.0 mg/kg on days 1–7, were inactive[AI0330]. The essential oil, administered orally to pregnant rats at a dose of 4.0 ml/kg on days 6–8, was active[AI0354]. Doses of 2.0 and 4.0 ml/kg, administered by gastric intubation on days 1–10, were inactive; 6.0 ml/kg[AI0310] and the seed oil administered intravaginally at a dose of 0.25 ml/animal[AI0373], were active.

Estrogenic effect. The seed oil, administered subcutaneously to ovariectomized

rats at a dose of 0.5 ml/animal[AI0100], and a dose of 0.3 ml/animal[AI0363] administered to normal rats, were inactive.

Estrous cycle disruption effect. Ethanol (95%) and petroleum ether extracts of the dried leaf, administered by gastric intubation to rats at a dose of 150.0 mg/kg for 7 days, were inactive[AI0348]. The seed oil, administered by gastric intubation to rats at doses of 2.0 and 4.0 ml/kg, was inactive. A dose of 6.0 ml/kg was equivocal[AI0310]. Ethanol (95%) extract of the dried bark, administered by gastric intubation to rats at a dose of 150.0 mg/kg for 7 days, was inactive. The petroleum ether extract was active. Ethanol (95%) extract of the dried stem, administered by gastric intubation to rats at a dose of 150.0 mg/kg for 7 days, was inactive, and the petroleum ether extract was active[AI0348].

Feeding deterrent activity. The chromatographic fraction of the acetone soluble fraction of the hexane extract of the dried kernel, at a concentration of 1.0%, was active on *Diabrotica undecimpunctata howardi* and *Acalymma vittata*. The chromatographic fraction from the ethanol extract and the ethanol (95%) extract produced strong activity on *Acalymma vittata* and *Diabrotica undecimpunctata howardi*. The hexane extract of the acetone insoluble fraction was active on *Diabrotica undecimpunctata howardi* and inactive on *Acalymma vittata*. Hexane extract of the acetone soluble fraction was inactive on *Diabrotica undecimpunctata howardi* and produced weak activity on *Acalymma vittata*[AI0318]. Hot water extract of the dried kernel, at a concentration of 200.0 ppm, was active on *Spodoptera frugiperda*[AI0347]. The dried entire plant was active on *Crocidolomia binotalis*[AI0322]. The essential oil was active when sprayed on rice seedlings vs rice planthopper and green rice leafhopper. The insect fecundity was reduced[AI0365]. The dried seed, at a concentration of 0.2%, was active on *Antigastra catalaunalis*[AI0278]. Ethanol (95%) extract of the seed cake was active on the male *Dacus cucurbitae* and *Rhopalosiphum nympheae*[AI0108]. Acetone extract of the dried seed was active vs rice hispa on treated rice seedlings. The ethanol (95%) and water extracts were active vs pulse beetles and jute hairy caterpillars. The hexane extract was active vs adult rice hispa on treated rice seedlings and brown rice planthopper, green rice leafhopper and rice hispa[AI0365]. Chloroform extract of the seed, at a dose of 0.063%, produced weak activity, while ethanol (95%) extract, at a dose of 0.016%, produced strong activity [AI0105]. The water and methanol extracts of the seed, at a dose of 0.031%, were active on the larvae of *Euproctis lunata*[AI0105]. Chromatographic fraction and ethanol (95%) extract of the dried seed were active on *Mythimna separata*[AI0323]. The dried seed was active on *Oryzaephilus surinamensis*[AI0204]. Ethanol (95%) and water extracts of the dried leaf were active vs pulse beetles and jute hairy caterpillars. Hexane extract was active vs brown rice planthopper and green rice leafhopper and rice hispa. The ethanol (95%) and ether extracts were active vs rice hispa[AI0365]. Ethanol (95%) extract of the dried seed, at a concentration of 0.1%, produced weak activity on *Bacillus thermoacidurans* applied to cantaloupe seeds[AI0295]. Methanol extract of the dried seed, at a concentration of 0.001%, was active on *Crocidolomia binotalis*[AI0288]. Seed oil, at a concentration of 0.1%, was active on *Henosepilachna vigintiotopunctata*[AI0352]. A concentration of 200.0 mcg/disc was active on *Reticulitermes speratus*[AI0175], the ED_{50} was 2.0 ppm on *Peridroma saucia*[AI0237]. Seed oil was active on *Spodoptera litura*[AI0339]. The fruit was active on *Schistocera gregaria* (Dese Root locust), when applied externally[AI0106].

Fertilization inhibition. The seed oil, at a concentration of 10-25%, was active in the mouse. The sperm/egg interaction was studied[AI0382].

Gastric mucus increase. Water extract of the dried leaf, administered intragastrically to rats at a dose of 40.0 mg/kg, was active vs stress-induced depletion of gastric wall adherent cells. The rats were pretreated for 5 days[AI0179].

Glutamate oxaloacetate transaminase inhibition. The dried leaf, in the ration of the chicken at a dose of 5.0% of the diet, was inactive[AI0255]. Water extract of the dried leaf, administered intraperitoneally to rats at a dose of 100.0 mg/kg, was active[AI0177]. Leaf homogenate, administered intragastrically to rats at a dose of 1.0 gm/kg, was active vs paracetamol-induced hepatotoxicity[AI0184].

Glutamate pyruvate transaminase inhibition. Leaf homogenate, administered intragastrically to rats at a dose of 1.0 gm/kg, was active vs paracetamol-induced hepatotoxicity[AI0184].

Glycogen content decrease. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a concentration of 500.0 mg/kg, was active[AI0188].

Glycogen synthesis stimulation. Ethanol (95%) extract of the dried leaf, at a concentration of 25.0 mg/ml, was inactive on the diaphragm[AI0188].

Hepatotoxic activity. Water extract of the dried leaf, administered intragastrically to rabbits at a dose of 2.328 mg/kg, was active. The rabbits showed a significant increase in serum alkaline phosphatase, glutamate oxalate-transamine and glutamate pyruvate-transaminase levels[AI0178]. Ethanol (95%) extract of the dried seed, administered subcutaneously to rats at a dose of 0.1 ml/animal, was active. The extract was administered daily to 3 groups for 6, 12, or 18 days. There was a significant decrease in the glycogen content of the liver and kidneys, and an increase in the adrenals. Protein content increased in the adrenals and decreased in the kidneys. The activity of acid phosphatase was increased in the adrenals and decreased in the kidneys. Histological features of these organs were also changed. All biochemical parameters remained unchanged in the spleen. In the liver, hepatocytes showed hyperchromatosis, vacuolation, congestion and necrosis. Kidneys showed severe damage, which included disorganization of tubular and cortical cells. There was no differentiation of cortical and tubular regions. The adrenals exhibited granulation and the cells in the medullary region revealed hypertrophy. The spleen did not show much significant change, except at 18 days dosing, when red and white pulps became undifferentiated[AI0376].

Humoral immunity stimulation. Water extract of the dried leaf, administered intraperitoneally to immunized rats at a dose of 100.0 mg/kg, was active[AI0177].

Hypertensive activity. Ethanol/water (1:1) extract of the dried leaf, administered intravenously to dogs at variable dosage levels, was inactive[AI0406].

Hypocholesterolemic activity. Water extract of the dried leaf, administered intraperitoneally to rats at a dose of 100.0 mg/kg, was active vs stress-induced hypercholesterolemia[AI0177].

Hypoglycemic activity. A mixture containing *Gymnema sylvestre*, *Syzygium cumini*, *Azadirachta indica*, and *Enicostema hyssopifolium*, administered intragastrically to rats at a dose of 40.0 mg/kg for 20 days, was inactive[AI0115]. Ethanol/water (1:1) extracts of the seedling root, fruit pulp, root wood, leaves and dried root, administered intragastrically to rats at a dose of 250.0 mg/kg, were inactive[AI0379]. Hot water extract of the dried leaf, administered intravenously to dogs at a dose of 0.15 ml/kg, was active. The extract was prepared by boiling 100 gm of fresh tender leaves with 200 ml of distilled water for 2 hours[AI0273]. Hot water extract of dried leaf, administered to rats and rabbits orally and by gastric intubation at a dose of 10.0 mg/kg, was inactive[AI0177].

The methanol extract and the methanol-insoluble fraction, administered intravenously to mice at a dose of 2.5 mg/kg, were active[AI0240]. Water extract of the dried leaf, administered orally to rats at a dose of 10.0 mg/kg, was inactive.

Hypotensive activity. Ethanol/water (1:1) extract of the stembark, administered intravenously to dogs at a dose of 50.0 mg/kg, was active[AI0107]. Hot water extract of the leaf, administered intravenously to guinea pigs at a dose of 30.0 mg/kg, and to rabbits at a dose of 5.0 mg/kg, was active[AI0198]. The dried leaf, administered intravenously to dogs at variable dosage levels, was inactive[AI0406].

Hypothermic activity. Acetone extract of the oven-dried leaf, administered intragastrically to mice at a dose of 100.0 mg/kg, was active. The effect was measured per rectum[AI0367]. Hot water extract of the dried leaf, administered by gastric intubation to male mice at a dose of 250.0 mg/kg, was active[AI0293].

Hypotriglyceridemia activity. Water extract of the dried leaf, administered intraperitoneally to rats at a dose of 100.0 mg/kg, was active[AI0177].

Immunomodulator activity. Water extract of the dried leaf, administered intragastrically to rats at a dose of 160.0 mg/kg 5 days before, was active vs stress-induced depletion of gastric wall-adherent cells[AI0179]. A dose of 40.0 mg/kg was active vs stress-induced (restraint) ulcers[AI0179]. Water extract of the dried stembark, in cell culture, was active on polymorphonuclear leukocytes[AI0346].

Immunostimulant activity. Ethanol (95%) extract of the dried stembark, at variable concentrations in cell culture, was active on human lymphocytes[AI0361]. Water extract of the dried leaf, administered intraperitoneally to rats at a dose of 100.0 mg/kg, was active vs stress-induced immunosuppression. Footpad thickness in response to the sheep red blood cell immunization and leukocyte migration was enhanced[AI0177].

Immunosuppressant activity. Water extract of the dried bark was active[AI0238].

Impaired development of fertilized ova. Seed oil, at a concentration of 10-25%, was active on the mouse sperm/egg interaction[AI0382].

Inotropic effect positive. Methanol extract and the methanol-insoluble fraction of the dried leaf, in cell culture at a concentration of 50.0 mcg/ml, were active on the atrium[AI0240].

Insect development inhibition. Acetone extract of the dried kernel, at a concentration of 0.01%, was active on *Spodoptera littoralis*[AI0347]. When also tested on *Spodoptera littoralis*, the butanol, pentane, carbon tetrachloride and isopropanol extracts, at a concentration of 0.05%, were inactive. The ethanol (95%), water and methanol extracts, at concentration of 0.01%, were active, and the kerosene extract, at a concentration of 1.0%, produced weak activity[AI0328]. The de-oiled seed powder, at a concentration of 10.0% of the diet, was active on *Macronesia fortunata*[AI0326]. Methanol (85%) extract of the dried seed, at a concentration of 0.01%, was active on *Nephotettix nigropictus*. Extract-treated rice seedling as the sole food source increased nymphal mortality and delayed adult emergence[AI0365]. Methanol extract of the dried fruit fixed oil was active on *Heliothis virescens*[AI0117]. Methanol extract of the dried fruit fixed oil was active on the larvae of *Pectinophora gossypiella*[AI0117]. Seed oil, at a concentration of 1.0%, was inactive on *Spodoptera littoralis*[AI0327]. Water extract of the dried entire plant, at a concentration of 0.6%, was active on *Spodoptera littoralis*[AI0327]. Water extract of the dried kernel was active on *Schistocera gregaria*[AI0332].

Insect repellant activity. The essential oil, at a concentration of 0.125%, was active on *Apis florea* vs olfactometer test[AI0217]. Ether and ethanol (95%) extracts of the dried seed were active on rice hispa. The methanol extract was active on *Nephotettix nigro-*

pictus[AI0365]. Petroleum ether extract of the dried leaf, at variable dosage levels, was active on *Rhyzopertha dominica*, *Sitophilus granarius*, and *Tribolium castaneum*[AI0302]. The acetone, butanol, chloroform, methanol and pentane extracts of the dried kernel were active on *Tetranychus cinnabarus*. The water extract was inactive[AI0329].

Insect sterility induction. Ether extract of the dried seed was active. Egg deposition of brown rice plant hopper and green rice leafhopper were reduced[AI0365]. The essential oil was active when sprayed on rice seedlings vs rice planthopper and green rice leafhopper. The insect fecundity was reduced[AI0365].

Insecticidal activity. Fixed oil was active on *Heliothis armigera*[AI0345]. Butyl-methyl-ether and water extracts of the dried seed were active on *Plutella xylostella* and *Echinochloa crus-galli* larvae, and the methanol extract was active on *Epilachna varivestis*, *Leptinotarsa decemlineata* and *Plutella xylostella*. Synergistic effect with piperonyl butoxide was determined[AI0374]. Chloroform, ethanol (95%) and ether extracts of the dried leaf, at a concentration of 1.0%, produced weak activity on the *Culex fatigans* larvae. Ethanol (70%) extract, at a concentration of 40.0% applied externally twice daily for 5-10 days on adults, was active in 5 cases of scabies[AI0266]. The water extract was active on *Phyllocnistis citrella* by contact poisoning[AI0405]. The dried leaf, at a concentration of 1.0%, was active 1 month after treatment. Moisture, ash, fiber, fat, protein and carbohydrate levels remained unaffected. A concentration of 2.0% produced weak activity on *Trogoderma granarium* in maize stored for 6 months. Changes in nutritional composition were proportional to insect damage[AI0185]. Petroleum ether extract of the dried leaf, at a concentration of 0.2%, was active on the *Culex fatigans* and *Culex pipiens* [AI0266], and a concentration of 1.0% was strongly active on *Culex fatigans* larvae[AI0208]. Chloroform and ether extracts of the dried leaf, at a concentration of 1.0%, and ethanol (95%) extract at a dose of 0.5%, were active on the *Culex fatigans* larvae[AI0285]. Decoction of the dried stembark, administered orally and externally, was active on patients with scabies[AI0313]. Hot water extract of the dried kernel was active on *Spodoptera frugiperda*, LC_{100} 2,000 ppm. The methanol extract, at a concentration of 10.0 ppm, was active[AI0347]. Methanol extract of the seed was active on *Epilachna varivestis*[AI0294]. Petroleum ether extract of the dried entire plant, at a concentration of 20.0 ppm, was active on *Culex quinquefasciatus*. A mortality rate of 25% was produced[AI0308]. The powdered seed, together with *Curcuma longa* root at a ratio of 4:1, was ground to form a paste. The paste was spread over the entire body daily. Ninety-seven percent of the 814 cases of scabies treated were cured within 15 days of the treatment[AI0170]. The seed cake was active on *Pyralis* species in a field test[AI0349]. The seed oil, at a concentration of 20.0 ppm, was active on *Ostrinia furunclis*. Concentrations of 0.005 microliters/insect and 1.4% were active on *Tessaratoma papillosa*, 0.3% was active on *Plutella xylostella* and 2.0% was active on *Piers rapae*[AI0256]. The seed, in the ration, was active on *Sitotroga cerealella*[AI0110]. The essential oil was active on rice planthopper and green rice leafhopper when sprayed on rice seedlings. The insects fecundity was reduced[AI0365]. The seed was active on *Asphondylium sesami*[AI0265]. Water extract of the dried leaf was inactive on *Aedes aegypti*, and produced weak activity on *Anopheles arabiensis*, MIC 1,000 ppm[AI0218]. Water extract of the dried kernel was active on *Culex fatigans* larvae[AI0333]. The kerosene extract, at a concentration of 1.0%, was active against *Trogoderma granarium* in maize stored for 6 months. After 1 month of treatment, the moisture, ash, fiber, fat, protein and carbohydrate level of the extract remained unaffected. The effect of the

kerosene extract was still positive 6 months after treatment[AI0185]. The powdered, dried kernel was active on the female *Callosobruchus chinensis* and C. *Maculatus*[AI0334].

Insulin release inhibition. Water extract of the fresh leaf, at a concentration of 1.0 mg/ml, was active on the rat uterus. The effect was caused by inhibition of serotonin release[AI0187].

Interferon induction stimulation. Ethanol/water (1:1) extract of the dried stem, at a concentration of 0.012 mg/ml in cell culture, was active on Ranikhet virus and inactive on vaccinia virus[AI0299].

Ionophoric activity. Water extract of the dried leaf, at a concentration of 1.0 mg/ml, was active on the rat uterus[AI0187].

Lactate dehydrogenase stimulation. The dried leaf, in the ration of the chicken at a dose of 5.0% of the diet, was active[AI0255].

Larval growth inhibition. Ether extract of the seed, at concentrations of 0.125%, 0.250%, and 0.375%, was active on *Sitophilus oryzae*[AI0277].

Larvicidal activity. The essential oil, at a concentration of 25.0 ppm, was active on the larvae of *Anopheles stephensi*[AI0366]. Methanol extract of the dried seed, at a concentration of 0.001%, was active on *Crocidolomia binotalis*[AI0376]. Water extract of the dried kernel was active on *Culex fatigans* larvae[AI0334]. The methanol extract, at a concentration of 15.0 mg/liter, produced weak activity on *Epilachna varivestis*. A concentration of 20.0 mg/liter was active[AI0263].

Leukocyte migration inhibition. Water extract of the dried bark was active on human blood. It increased the production of migration inhibition factor by lymphocytes[AI0372].

Leukocytosis activity. Decoctions of the fruit, leaf and stem, administered intragastrically to rats at a concentration of 1.6%, were active[AI0189].

Liver effects. Decoction of the dried entire plant, taken orally by adults at a dose of 100.0 ml, was active. A mixture of *Phyllanthus emblica, Terminalia chebula, Picrorhiza kurroa, Swertia chirata*, and *Azadirachta indica* was used. The dose was taken for 1–5 weeks. Eighteen of 20 cases of jaundice were cured. The effect on serum albumin was very satisfactory[AI0371].

Malate dehydrogenase inhibition. Water extract of the dried flowers produced 77% inhibition on *Setaria digitata* enzyme[AI0183].

Malate dehydrogenase stimulation. Water extract of the dried leaf, at a concentration of 0.33%, was active on enzyme obtained from *Setaria digitata*. The effect was activated 24%[AI0183].

Malic enzyme inhibition. Water extract of the dried flowers, at a concentration of 0.033%, was active on enzyme obtained from *Setaria digitata*. The activity was inhibited 100%. Water extract of the dried leaf, at a concentration of 0.033%, was active on enzyme obtained from *Setaria digitata*. The effect was activated 7%[AI0183].

Mating inhibition. Ethanol (80%) extract of the dried leaf, administered intragastrically to male rats at a dose of 100.0 mg/kg daily for 21 days, was inactive[AI0377].

Mitogenic activity. Water extract of the seed, in cell culture at a concentration of 50.0 mcg/ml, was active on lymphocytes[AI0231].

Molluscicidal activity. Water extract of the dried bark of *Azadirachta indica* and *Acacia nilotica*, at a concentration of 100.0 ppm, was active on *Biomphalaria pfeifferi* and *Bulinus truncatus*. The water extract of the bark of *Azadirachta indica* and *Hydnoraa absyssinica*, at a concentration of 75.0 ppm, was active on *Anguina tritic* and *Biomphalaria pfeifferi*. A preparation consisting of the water extract of the bark of *Azadirachta indica* and tannic acid, at a concentration of 75.0 ppm, was active on *Biomphalaria pfeifferi* and *Bulinus truncatus*[AI0340]. Methanol extract of the dried bark, at a concentration of 100 ppm, was active on *Biomphalaria pfeifferi* and *Bulinus truncatus*[AI0335]. Water extract

of the dried fruit, at a concentration of 0.5%, was active on *Melania scabra*[AI0353].

Mutagenic activity. Acetone extract of the seed oil, on agar plate at a concentration of 200.0 mg/plate, and the DMSO extract, at a concentration of 500.0 mg/plate, was inactive on *Salmonella typhimurium* TA98 and TA100[AI0324]. Petroleum ether extract of the fresh leaf, on agar plate at a concentration of 0.1 ml/plate, was inactive on *Salmonella typhimurium* TA100, TA1535, TA1537 and TA98. Metabolic activation had no effect on the results[AI0220].

Myodegeneration effect. Powdered dried leaf, in the ratio of rats at a dose of 25% of the diet, was active[AI0176].

Nematocidal activity. Decoction of the bark, at a concentration of 10.0 mg/ml, was inactive on *Toxacara canis* [AI0247]. Decoction of the seed was inactive on *Toxacara canis*[AI0247]. Water extract of the dried bark, at a concentration of 10.0 mg/ml, was active on *Toxacara canis* [AI0253].

Nephrotoxic activity. Ethanol (95%) extract of the dried seed, administered subcutaneously to rats at a dose of 0.1 ml/animal, was active. The extract was administered daily to 3 groups for 6, 12, or 18 days. There was a significant decrease in the glycogen content of the liver and kidneys, and an increase in the adrenals. Protein content increased in the adrenals and decreased in the kidneys. The activity of acid phosphatase was increased in the adrenals and decreased in the kidneys. All biochemical parameters remained unchanged in the spleen. Histological features of these organs were also changed. In the liver, hepatocytes showed hyperchromatosis, vacuolation, congestion and necrosis. Kidneys showed severe damage, which included disorganization of cortical and tubular cells. There was no differentiation of cortical and tubular regions. Adrenals exhibited granulation and the cells in the medullary region revealed hypertrophy. The spleen did not show significant change, except at 18 days dosing, red and white pulps became undifferentiated[AI0376].

Nerve regeneration. Water extract of the dried leaf, at a concentration of 500.0 gm/liter exposed for 6 days, produced strong activity on *Cuscuta reflexa* seeds[AI0257].

Neuromuscular blocking activity. Acetone extract of the oven-dried leaf, administered intragastrically to mice, was active vs inclined plane test, ED_{50} 30.0 mg/kg[AI0367].

Oviposition inhibition. The *Azadirachta indica* preparation "neemrich", at a concentration of 1.0 mg/sq cm, was active on potato tuber moth[AI0244].

Oxidative burst inhibition. Water extract of the dried stembark, at a concentration of 0.1 mg/ml, was active vs chemiluminescence assay with activated polymorphonuclear leukocytes[AI0246].

Phytotoxic effect. Butanol and chloroform extracts of the dried kernel were active on the bean leaf[AI0329].

Plant germination inhibition. Butanol, chloroform/methanol (1:1), ether, ethanol (95%), petroleum ether and chloroform extracts of the dried stem, at a concentration of 500.0 gm/liter, produced weak activity. The water extract was active and the hexane extract was inactive on *Cuscuta reflexa* seeds after 6 days of exposure to the extracts. Butanol, ethanol (95%), petroleum ether and water extracts of the dried root, at a concentration of 500.0 gm/liter, were active. The chloroform, chloroform/methanol (1:1), ether and hexane extracts produced weak activity on the seeds of *Cuscuta reflexa* after 6 days of exposure to the extracts. Butanol, ether and petroleum ether extracts of the dried leaf, at a concentration of 500.0 gm/liter for 6 days, were active. The chloroform and hexane extracts produced weak activity, and chloroform/methanol (1:1) and ethanol (95%) extracts produced strong activity on the seeds of *Cuscuta reflexa*[AI0257].

Plant growth inhibition. Butanol, chloroform/methanol (1:1) and water extracts, at

a dose of 500.0 gm/liter, were active. The ether, ethanol (95%), hexane, and petroleum ether extracts were inactive on the seedling length, weight and dry weight of the *Cuscuta reflexa* plant, after 6 days of exposure to the extracts. Butanol and ethanol (95%) extracts of the dried leaf, at a concentration of 500.0 gm/liter for 6 days, produced strong activity. Chloroform extract was inactive, chloroform/methanol (1:1) and water extracts were active, and ether, hexane and petroleum ether extracts produced weak activity on *Cuscuta reflexa* seedlings. The length, weight and dry weight were measured. Butanol, ethanol (95%), petroleum ether and water extracts of the dried root, at a concentration of 500.0 gm/liter, were active. The chloroform, chloroform/methanol (1:1), ether and hexane extracts produced weak activity on *Cuscuta reflexa* after 6 days of exposure to the extracts. Seedling length, weight and dry weight were measured[AI0257].

Plant growth promoter. Seed cake, in a field test, was active on *Azolla pinnata*[AI0349].

Plaque formation suppressant. Water extract of the seed was inactive on *Streptococcus mutans*, IC_{50} >1,000 mcg/ml. The methanol/water (1:1) and methanol extracts were active, IC_{50} 250.0 mcg/ml and 400.0 mcg/ml, respectively[AI0343].

Plasma bilirubin increase. The dried leaf, in the ration of chicken at a dose of 2.0% of the diet, was active[AI0255].

Platelet stimulant. Water extract of the dried leaf, administered orally to mice at a dose of 0.1 gm/kg, was active[AI0355].

Polygalacturonase inhibition. Hot water extract of the bark was active[AI0111].

Polymorphonuclear leukocyte activation inhibitor. Water extract of the dried bark was active on blood vs oxygen radical production of activated polymorphonuclear leukocytes[AI0372].

Potassium depletion. Decoction of the fruit, leaf and stem, administered intragastrically to rats at a concentration of 0.4%, was active[AI0189].

Protease (HIV) inhibition. Water and methanol extracts of the dried seed, at a concentration of 200.0 mcg/ml, were equivocal[AI0193].

Proteolytic activity. Water extract of the dried gum, at variable concentrations, was active[AI0391].

Protopectinase inhibition. Hot water extract of the bark was active[AI0111].

RBC stimulant activity. Decoction of the fruit, leaf and stem, administered intragastrically to rats at a concentration of 0.4%, was active[AI0189].

RBC synthesis antagonist. Dried leaf in the ration of chicken at a dose of 5.0% of the diet, was active[AI0255].

Respiratory depressant. Acetone extract of the oven-dried leaf, administered intragastrically to mice at a dose of 200.0 mg/kg, was active[AI0367].

Serotonin antagonist activity. Methanol extract and the methanol-insoluble fraction of the dried leaf, in cell culture at variable concentrations, were inactive on ileum[AI0240].

Smooth muscle relaxant activity. Water extract of the fresh leaf, at a concentration of 1.0 mg/ml, was inactive on guinea pig ileum, seminal vesicles and vas deferens, rabbit duodenum and rat stomach (fundus) and seminal vesicle[AI0187].

Smooth muscle stimulant activity. Water extract of the fresh leaf, at a concentration of 1.0 mg/ml, was inactive on guinea pig ileum, seminal vesicles and vas deferens, rabbit duodenum and rat stomach (fundus) and seminal vesicle[AI0187].

Spasmolytic activity. Ethanol/water (1:1) extract of the seedling root was inactive on rat uterus[AI0379]. Ethanol/water (1:1) extract of the stemwood, dried root, fruit pulp, leaf, and root wood was inactive on rat uterus[AI0379].

Spermicidal effect. Ethanol (80%) extract of the dried leaf, administered intragastrically to male rats at a dose of 100.0 mg/ani-

mal daily for 21 days[AI0377], and the leaves, at a dose of 20-60 mg/animal[AI0380], were active. Mating inhibition effect was negative. Saponin fraction of the dried seed, at a concentration of 25%, was active on the human sperm[AI0191]. The dried seed, administered intravaginally, was active in baboon, monkey and rabbit[AI0192].

Spontaneous activity reduction. Acetone extract of the oven-dried leaf, administered intragastrically to mice at a dose of 100.0 mg/kg, was active[AI0367].

Testosterone level decrease. Decoction of the fruit, leaf, and stem, administered intragastrically to rats at a concentration of 0.1%, was active[AI0189].

Toxic effect. Ethanol (95%) extract of the dried seed, administered subcutaneously to rats at a dose of 0.1 ml/animal, was active. The extract was administered daily to 3 groups for 6, 12, or 18 days. There was a significant decrease in the glycogen content of the liver and kidneys, and increase in the adrenals. Protein content increased in the adrenals and decreased in the kidneys. The activity of acid phosphatase was increased in the adrenals and decreased in the kidneys. All biochemical parameters remained unchanged in the spleen. Histological features of these organs were also changed. In the liver, hepatocytes showed hyperchromatosis, vacuolation, congestion and necrosis. Kidneys showed severe damage, which included disorganization of cortical and tubular cells. There was no differentiation of cortical and tubular regions. Adrenals exhibited granulation and the cells in the medullary region revealed hypertrophy. The spleen did not show significant change, except at 18 days dosing, red and white pulps became undifferentiated[AI0376]. Ethanol (95%) extract of the dried leaf, administered intragastrically to mice at a dose of 10.0 gm/kg, was inactive[AI0258]. Toxic effect was observed by an adult male who consumed 1,000 ml of hot water extract of the leaf[AI0369]. Ethanol (95%) extract of the seed cake, in the ration of lamb at a concentration of 20.0% of the diet, was inactive, and at a concentration of 30% of the diet, was active[AI0297]. The seed cake, at a concentration of 84% of the diet of rats, was inactive[AI0180]. Ethanol/water (1:1) extract of the dried leaf, administered by gastric intubation and subcutaneously to mice at a dose of 10.0 gm/kg, was inactive[AI0271]. Hot water extract of the leaf, administered intravenously to guinea pigs of both sexes at a dose of >40.0 mg/kg, was active[AI0198].

Toxicity assessment. Ethanol (70%) extract of the fresh bark and leaf, when administered by gastric intubation to mice, resulted in LD_{50} 13.0 gm/kg[AI0260]. Ethanol/water (1:1) extract of the dried seed, administered intraperitoneally to mice of both sexes, resulted in LD_{50} 681.0 mg/kg[AI0284]. Ethanol/water (1:1) extract of the stem-bark, administered intraperitoneally to mice, resulted in LD_{50} >1.0 gm/kg [AI0107]. Ethanol/water (1:1) extract of the stemwood, administered intraperitoneally to mice, resulted in LD_{50} >1000 mg/kg[AI0379]. Ethanol/water (1:1) extract of the dried root, fruit pulp, root wood, and leaf, when administered intraperitoneally to mice, resulted in LD_{50} 681.0 mg/kg[AI0379].

Tranquilizing effect. Hot water extract of the dried leaf, administered by gastric intubation to rats at a dose of 500.0 mg/kg, produced weak activity[AI0293].

Uric acid increase. The dried leaf, in the ration of chicken at a dose of 2.0% of the diet, was active[AI0255].

Wound healing acceleration. Leaf juice, applied externally on calves, was active[AI0181].

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7 Echinacea angustifolia

L.

Common Names

American coneflower	USA	Kansas snakeroot	USA
Black sampson	USA	Ksapitahako	USA
Black susans	USA	Mika-Hi	USA
Comb flower	USA	Nigger head	USA
Cone flower	USA	On glakcapi	USA
Echinaceae	USA	Pale-purple coneflower	USA
Echinaceae	Europe	Purple cone flower	USA
Hedgehog	USA	Sampson root	USA
Icahpe Hu	USA	Sapariou hahts	USA
Inshtogahte-Hi	USA	Scurvy root	USA
Kansas niggerhead	USA		

BOTANICAL DESCRIPTION

A perennial herb of the COMPOSITAE family that grows up to 45 cm. The leaves are sparse, solitary, lanceolate to linear, opposite or alternate with rough surface, 7.5 to 20 cm long, entire margined on slender petioles. The dried rhizome is grayish-brown, often twisted, longitudinally furrowed, up to about 1 cm in diameter. The transverse section shows a thin bark and a yellowish porous wood flecked with black. The flower heads are large and solitary on terminal peduncles with spreading ray florets. The bracts are in a number of rows. The bracts are dry or leafy, rigid, thorny tipped, and longer than the conical erect disc florets. The reddish or occasionally white florets are conspicuous, usually sterile lingual florets and 3 cm long.

ORIGIN AND DISTRIBUTION

This species grows in the western United States and in Europe. Other species grow in the middle and eastern United States. It is now cultivated in Europe and North America.

TRADITIONAL MEDICINAL USES

India. The root is used as an antivenin[EA0135].

Italy. Hot water extract of the dried leaf is taken orally for inflammations[EA0146].

USA. Decoction of the fresh leaf, and root are taken orally to treat sore mouth and gums. Externally, the decoction is used to relieve pain, and the tea is rubbed onto the

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sore neck. The tea, when allowed in contact with sore tooth, relieves toothache[EA0132]. Hot water extract of the rhizome is taken orally as an aphrodisiac[EA0126]. Hot water extract of the rhizome and root is used externally as an antiseptic. The extract is taken orally as a peripheral vasodilator, for headaches, to treat enlarged glands and for stomach cramps[EA0125]. Fluid extract of the dried rhizome and root is taken orally in 2 to 4 gram doses as a sodorific in malaria, to improve the appetite, to treat the bites of poisonous snakes and insects, as a diaphoretic, sialagogue, diuretic, aphrodisiac, cholagogue, analgesic, to treat tuberculosis and as a blood purifier in treating such conditions as septicemia, typhoid fever, furunculosis, carbuncles, abscesses, diptheria, and gangrene. The fluid extract is also administered by gastric intubation to control diarrhea in calves [EA0111]. A medical account in 1905 highlighted the effectiveness of *Echinacea angustifolia* in a number of septic conditions, such as blood poisoning, tetanus, insect and snake bites, and septic fevers. It claimed that in 1870, Dr. H. F. C. Meyer of Nebraska declared that in several instances he had allowed himself to be bitten by a rattlesnake, and had then bathed the bite in strong tincture of *Echinacea* in addition to taking several drams of the tincture internally [EA0135]. The fresh fruit is eaten when thirsty or perspiring. The root is used to treat pain in the bowels, bellyache, and toothache [EA0132]. The root is used for healing inflammations and wounds, and as an analgesic[EA0100]. Fluid extract of the dried root is taken orally for impotency, blood disorders, typhus, and meningitis. Rectally, the fluid extract is used for the treatment of hemorrhoids, and topically for the treatment of wounds and carbuncles. Hot water extract of the dried root is taken orally by the Sioux Indians for wound healing and as a snake bite remedy. It leaves a warm and tingling sensation in the mouth and is sufficiently irritating to produce a prickly sensation and a slight blistering effect on mucous surfaces of the lips. Tincture of the root is taken orally to relieve nausea and high fevers, to alleviate diarrhea accompanying septic conditions, and to relieve the pain of gastric cancer. The tincture is considered a valuable substitute for morphine in many cases[EA0105]. It is taken orally for smallpox to abate the fever, and is used externally for the irritation and inflammation of poison ivy dermatitis[EA0107]. The fresh root is scraped and administered internally to hasten the healing of wounds. Infusion of the root is taken orally in septic conditions as an adjunct to surgical treatments[EA0105]. The hot water extract of dried root is taken orally as a diaphoretic. The root is steeped in a cup of boiling water for half an hour. A tablespoonful is then taken 3 to 6 times a day[EA0181]. Water extract of the fresh root is used externally as an antidote for snakebite and other bites, stings, and poisonous conditions. The extract is also taken orally for rabies, mumps, bellyache, pain in the bowels, measles, and as a cough medicine. It is used externally to treat putrefied wounds, and as an eyewash to treat sore eyes. To relieve inflammation, the ground up root is applied to areas of inflammation. The macerated root is applied externally as a local anaesthetic. A piece of root is chewed to treat colds, sore throat, and to stimulate the flow of saliva. Decoction of the fresh root is taken orally to treat rheumatism and arthritis. The root is made into a salve and used externally to treat rheumatism and arthritis. Decoction of the root, mixed with *Mentzelia laevicaulis* (blazing star), is taken orally to treat smallpox. The root, mixed with puffball spores (*Lycoperdon*) and skunk oil, is used externally to treat boils. The root is cut up and put into the feed of livestock as a treatment to improve the appetite [EA0132].

CHEMICAL CONSTITUENTS
(ppm unless otherwise indicated)

Alkanes (C10-C33): Lf [EA0160, EA0138]
Ash: Rt[EA0106]
Betaine: Rt 0.1%[EA0108]
Caffeic acid: Pl[EA0136,EA0119]
Caftaric acid: Rt[EA0131]
Cerotic acid: Rt[EA0108]
Chichoric acid dimethyl ether: Pl[EA0140]
Chichoric acid monomethyl ether: Rt[EA0140]
Chichoric acid: Pl[EA0140]
Chicoric acid: Pl[EA0131,EA0136,EA0119]
Chlorogenic acid: Aer[EA0118]
Chlorogenic acid iso: Aer[EA0118]
Cynarin: Rt[EA0133,EA0184,EA0131,EA0155,EA0156]
Dodeca-2-4-8-10-tetraen-1-oic acid iso-butylamide: Rt 0.03%[EA0115]
Dodeca-2-trans-4-cis-10-cis-trien-8-ynoic acid iso-butylamide: Rt[EA0150]
Dodeca-2-trans-4-cis-diene 8,10-diynoic acid iso-butylamide: Pl[EA0150]
Dodeca-2-trans-4-trans-10-cis-trien-8-ynoic acid iso-butylamide: Aer[EA0150]
Dodeca-2-trans-4-trans-8-cis-10-cis-tetraenoic acid iso-butylamide: Rt, Aer[EA0150]
Dodeca-2-trans-4-trans-8-cis-10-trans-tetraenoic acid iso-butylamide: Rt, Aer[EA0150]
Dodeca-2-trans-4-trans-8-cis-trienoic acid iso-butylamide: Aer[EA0150]
Dodeca-2-trans-4-trans-dienoic acid iso-butylamide: Rt[EA0150]
Dodeca-2-trans-ene-8,10-diynoic acid 2-methyl-butylamide: Rt[EA0150]
Dodeca-2-trans-ene-8,10-diynoic acid iso-butylamide: Rt[EA0150]
Dodeca-cis-2-trans-4-diene-8,10-diyn-1-oic acid iso-butylamide: Rt 0.30%[EA0115]
Dodeca-trans-2-cis-4-cis-10-trien-8-ynoic acid iso-butylamide: Aer, Rt, 137[EA0149,EA0151,EA0103,EA0155,EA0156]
Dodeca-trans-2-cis-4-cis-8-trienoic aci iso-butyramide: Pl[EA0119]
Dodeca-trans-2-cis-4-dien-8,10-diyne acid iso-butyramide: Pl[EA0119]
Dodeca-trans-2-cis-4-diene-8,10-diynoic acid iso-butylamide: Rt 68[EA0149]
Dodeca-trans-2-cis-4-diene-8,10-diynoic acid-n-iso-butylamide: Aer[EA0118]
Dodeca-trans-2-ene-8,10-diynoic acid 2-methyl-butylamide: Rt 68[EA0149]
Dodeca-trans-2-ene-8,10-diynoic acid iso-butylamide: Rt 0.024%[EA0149,EA0133]
Dodeca-trans-2-trans-4-cis-10-triend-8-ynoic acid-n-iso-butylamide: Aer[EA0118]
Dodeca-trans-2-trans-4-cis-8-cis-10-tetraenoic acid iso-butylamide: Rt[EA0149]
Dodeca-trans-2-trans-4-cis-8-cis-10-tetraenoic acid iso-butyramide: Pl[EA0119]
Dodeca-trans-2-trans-4-cis-8-cis-10-tetraenoic acid-n-iso-butylamide: Aer[EA0118]
Dodeca-trans-2-trans-4-cis-8-trans-10-tetraenoic acid iso-butylamide: Rt[EA0149]
Dodeca-trans-2-trans-4-cis-8-trans-10-tetraenoic acid iso-butyramide: Pl[EA0119]
Dodeca-trans-2-trans-4-cis-8-trans-10-tetraenoic acid-n-iso-butylamide: Aer[EA0118]
Dodeca-trans-2-trans-4-cis-8-trienoic acid-n-iso-butylamide: Aer[EA0118]
Dodeca-trans-2-trans-4-dienoic acid iso-butylamide: Rt 0.01%[EA0149]
Dodeca-trans-2-trans-4-trans-10-trien-8-yne acid iso-butyramide: Pl[EA0119]
Echinacea Factor A: Rt[EA0173]
Echinacea Factor B: Rt[EA0173]
Echinacea polysaccharide: Pl[EA0157,EA0145]
Echinacein: Rt 400[EA0100]
Echinacin B: Rt[EA0180]
Echinacoside 1: Rt[EA0139]
Echinacoside 2: Rt[EA0139]
Echinacoside: Pl[EA0133,EA0184,EA0154,EA0161,EA0140]
Echinolone: Rt 30[EA0162,EA0159]
Essential oil: Rt 0.04-1.30%[EA0114,EA0176,EA0101]
Glycine-betaine: Fl 0.805%, Lf 0.113%, St 0.49%, Rt 0.31%[EA0148]
Hexadeca-2-trans-9-cis-diene-12,14-diynoic acid iso-butylamide: Rt[EA0150]
Hexadeca-trans-2-cis-9-diene-12,14-diynoic acid iso-butyl amide: Rt 6.8[EA0149]
Hydrocarbons: Rt EO[EA0175]
Inulin: Rt 5-9%[EA0108]
Linoleic acid: Rt[EA0108]
Myristic acid: Rt[EA0101]
Oleic acid: Rt

Palmitic acid: Rt[EA0108]
Pentadec-1-ene: Rt[EA0101]
Pentadec-8-en-2-one: Rt 0.4%[EA0112]
Pentadec-trans-9-ene-1i,13-diyn-2-one 8-hydroxy: Rt[EA0142]
Pentadeca-1-cis-8-diene: Rt[EA0101]
Pentadeca-2-trans-9-cis-diene-12,14-diynoic acid iso-butylamide: Rt[EA0150]
Pentadeca-trans-2-cis-9-diene-12,14-diynoic acid iso-butylamide: Rt[EA0149]
Pentadeca-trans-9-cis-13-dien-11-yn-2-one-8-hydroxy: Rt[EA0141]
Pentadeca-trans-9-cis-13-diene-11-yn-2-one-8-hydroxy: Rt[EA0142]
Pentadeca-trans-9-en-11,13-diyn-2-one-8-hydroxy: Rt[EA0141]
Rutin: Pl[EA0136,EA0119]
Sitosterol,beta: Rt[EA0150]
Sucrose: Rt 6.92%[EA0179]
Tartaric acid,2-caffeoyl: Pl[EA0136,EA0119]
Tetradeca-5,12-diene, 2-methyl: Rt[EA0101]
Tetradeca-6,12-diene, 2-methyl: Rt[EA0101]
Tridec-1-ene-3,5,7,9,11-pentayne: St 0.05%, Fl 0.08%, Rt 0.9%[EA0112]
Tridec-1,3-diene-5,7,9,11-tetrayne: Rt 0.01%[EA0112]
Trideca-1,5-diene-7,9,11-triyne, 3,4-epoxy: Rt 1.0%, St 0.01%[EA0112]
Trideca-2-trans-7-cis-diene-10,12-diynoic acid iso-butylamine: Rt[EA0150]
Trideca-8,10,12-triene-2,4,6-triyne: Rt 0.02%, Fl tr[EA0112]
Trideca-trans-2-cis-7-diene-10,12-diynoic acid iso-butylamide: Rt 6.8[EA0149]
Tussilagine: Pl[EA0143]
Tussilagine,iso: Pl[EA0143]
Undeca-2-cis-4-trans-diene-8,10-diynoic acid iso-butylamide: Rt[EA0150]
Undeca-2-cis-ene-8,10-diynoic acid, 2-methyl-butylamide: Rt[EA0150]
Undeca-2-cis-ene-8,10-diynoic acid iso-butylamide: Rt[EA0150]
Undeca-2-trans-4-cis-8,10-diynoic acid iso-butylamide: Rt[EA0150]
Undeca-2-trans-4-cis-diene-8,10-diynoic acid iso-butylamide: Aer[EA0150]
Undeca-2-trans-ene-8,10-diynoic acid iso-butylamide: Rt[EA0150]
Undeca-cis-2,8,10-triynoic acid iso-butylamide: Rt 31[EA0149]
Undeca-cis-2-ene-8,10-diynoic acid, 2-methyl-butylamide: Rt 6.8[EA0149]
Undeca-cis-2-ene-8,10-diynoic acid iso-butylamide: Rt 3.4[EA0149]
Undeca-cis-2-trans-4-diene-2,4-diynoic acid iso-butylamide: Rt 0.03%[EA0115]
Undeca-cis-2-trans-4-diene-8,10-dynoic acid iso-butylamide: Rt 13.7[EA0149]
Undeca-trans-2-cis-4-dien-8,10-diyne acid iso-butylamide: Pl[EA0119]
Undeca-trans-2-cis-4-diene-8,10-diynoic acid iso-butylamide: Rt 10.3[EA0149]
Undeca-trans-2-cis-4-diene-8,10-diynoic acid-n-iso-dutylamide: Aer[EA0118]
Verbascoside: Aer[EA0118]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Analgesic activity. Tincture of the dried root, administered subcutaneously to male adults at variable dosage levels, produced analgesia for 10 to 30 minutes. No adverse effect was noted[EA0107].

Anesthetic activity. Extract of the root, taken orally by adults, produced a numbing effect[EA0100].

Antiallergenic activity. Extract of the entire plant, in combination with lactic acid, was active when taken orally[EA0158].

Antiinflammatory activity. Acetic acid extract of the dried root, applied externally to the mouse at a dose of 0.045 mg/ear, was active vs croton oil edema, results significant at $p< 0.01$ level. When administered intravenously to rats at a dose of 5.0 mg/kg, the result was positive vs carrageenin-induced pedal edema. Results significant at $p< 0.05$ level[EA0168]. Ethanol (80%) extract of the dried leaf, administered by gastric intubation to male rats at a dose of 100.0 mg/kg, was inactive vs carrageenin-induced pedal edema[EA0146]. Water extract of the dried root, administered externally to mice, was active vs croton oil ear test, ID_{50} 450.0 mcg/ear[EA0147]. The polysaccharide fraction, at a concentration of 45.0 mcg/ear, was active vs croton oil-induced irritation. The polysaccharide fraction, administered intravenously to rats at a dose of 0.5 mg/kg, was active vs carrageenin-induced pedal edema[EA0171].

Antimycobacterial activity. Ethanol (95%) extract of the entire plant, at a dilution of 1:80 in broth culture, was active on *Mycobacterium tuberculosis* H37RVTMC 102[EA0153].

Antitoxic activity. Tincture of the dried root, taken orally by adults at variable dosage levels, was active. A series of care reports on the treatment of conditions such as septicemia, abscesses, boils, spider bites, scarlet fever and sequelae, ulcerative stomatitis and gangrenous wounds was positive[EA0110].

Antiviral activity. The dried entire plant, taken orally by adults of both sexes at a dose of 3.0 gm/day, was active on HIV virus. A phase 1 trial of *Echinacea angustifolia* in HIV-positive individuals was conducted. Fourteen of the patients with CD4 counts ranging from 6 to 600/mm^3 (mean 269) and viral loads (log 10) ranging from <2.3 to 5.4 (mean 4.68) were enrolled, and completed the study included the analyses. Each had been on a stable anti-retroviral regimen or no anti-retroviral from at least the previous 12 weeks. Each received a 12-week course of *Echinacea angustifolia* at 1000 mg 3 times a day. Viral HIV loads, CD4 counts, natural killer cell killing activity against K562 target cells, clinical assessment, and laboratory monitoring for toxicity was done every 2 weeks. There was no clinical or laboratory toxicities noted during the study. At 12 weeks there was no significant difference in mean CD4 count compared to baseline; however, there was an overall 0.32 (log 10) reduction in viral load (mean 4.36, $p< 0.05$). *Echinacea angustifolia* did not demonstrate any direct anti-HIV killing activity in vitro and there was no change in natural killer cell activity. Thus, *Echinacea* was safe and associated with a significant reduction in viral load in HIV-positive individuals in this pilot study[EA0123]. Ethanol extract of the leaf (defatted with petroleum ether), at a concentration of 1.0 mg/ml in cell culture, was inactive on Influenza Virus PR8[EA0127]. Water extract of the dried root, at a concentration of 10.0% in cell culture, was inactive on Herpes virus type 2, Influenza virus A2 (Manheim 57), Poliovirus 11 and Vaccina virus[EA0183].

Cardiotoxic activity. Tincture of the entire plant, administered by perfusion to the rabbit heart, was active [EA0102].

Cytotoxic activity. Ethanol extract of leaf, (defatted with petroleum ether), at a concentration of 0.5 mg/ml in cell culture, was inactive on bovine endocardiac cells[EA0127]. Water extract of the dried root, at a concentration of 10.0% in cell culture, was inactive on HELA cells[EA0183].

Dermatitis improved. Hydro-alcoholic extract of the entire plant, administered to adults of both sexes at a dose of 400.0 mg/person, was active on the skin. The biological activity reported has been patented as a treatment for psoriasis and neurodermatitis[EA0121].

Diaphoretic activity. Tincture of dried root, taken orally by adults at a dose of 0.5 ml per person, was active. Each of 6 subjects received the preparation daily for 13 days. Excessive thirst and perspiration resulted. Blood sugar fluctuated as much as 20 mg, chlorides as much as 55 mg. Blood cholesterol first increased, then dropped to normal or even subnormal level[EA0113].

Glutamate oxaloacetate transaminase-inhibition. Lyophilized extract of the dried root, at a concentration of 0.32 mg/gm, was active on the rat liver. The preparation contained a mixture of *Echinacea purpurea*, *Echinacea angustifolia*, *Babtisia tinctoria*, and *Thuja occidentalis*. Results significant at $p< 0.05$ level[EA0169].

Glutamate pyruvate transaminase inhibition. Lyophilized extract of the dried root, at a concentration of 0.32 mg/gm, was inactive on the rat liver. The preparation contained a mixture of *Echinacea purpurea*, *Echinacea angustifolia*, *Babtisia tinctoria*, and *Thuja occidentalis*. Results significant at $p< 0.05$ level[EA0169].

Hemagglutinin activity. Saline extract of the dried seed, at a concentration of 10%, was inactive on human red blood cells[EA0164].

Hyaluronidase inhibition. Butyl acetate, chloroform, and acetic acid extracts of the dried root were active, IC_{50} 0.50 mg/ml, 0.62 mg/ml, and 0.44 mg/ml, respectively[EA0131]. The commercial product echinacin, at a concentration of 1:16 on agar plate, was active on *Escherichia coli* HS-30[EA0178]. Water extract of the dried root, administered subcutaneously to male guinea pigs at a dose of 0.3 ml/animal, was active. The guinea pigs were infected intradermally with *Streptococcus* strain MSS-1 and the effects of cortisone and echinacin (the water extract of the root) on the infection were observed. After pre-treatment with cortisone, the infection spreads rapidly in the area. Pretreatment with echinacin localized the infection[EA0174]. The effect of salvarsan on *Trypanosoma rhodesiense* infection of the white mouse was studied in combination with hyaluronidase. The effect of hyaluronidase depends on the dose of salvarsan given. The action of hyaluronidase was counteracted by echinacin[EA0172].

Hypotensive activity. Tincture of the entire plant, administered intravenously to the rabbit, was inactive[EA0102].

Immunostimulant activity. Ethanol (95%) extract of the dried root, administered orally to chicken at a dose of 0.4 ml/animal in 2 doses, was active. The preparation 'Influex' contained extracts of *Echinacea angustifolia* and *Aconitum napellus*, as well as dilutions of *Apis mellifica* and *Lachesis muta* venoms. Serum IgG, IgA and IgM increased[EA0152]. Water extract of the dried root, taken orally by adults, was active. In 26 controlled studies, 30 of the 34 treatments showed improved parameters over controls, but studies had low methodological quality[EA0129]. Extract of the entire plant, taken orally by adults of both sexes at a dose of 3.0 ml/day, was inactive. No significant changes were observed in absolute counts of leukocytes, lymphocytes, monocytes or granulocytes. The dose was inactive on leukocytes; there was no enhancement of cytokine production[EA0117]. Hydro-alcoholic extract of the entire plant, taken orally by adults of both sexes at a dose of 5.0 ml, was inactive. In a randomized, double-blind, placebo-controlled study assessing the efficacy of *Echinacea* in URT infections, 32 subjects received 50 drops twice daily 5 days a week for a total of 12 weeks. *Echinacea* extract did not decrease the severity or duration of the symptoms when compared with the placebo[EA0122]. Water extract of the entire plant, administered intramuscularly to adults at variable dosage levels, was active. A review in 1965 stated that echinacin, an aqueous extract prepared from *E. purpurea*, *E. pallida* and/or *E. angustifolia*, can be used internally to activate reticuloendothelium to increase alpha, beta and gamma globulin and promote antibody formation[EA0177]. Polysaccharide fraction of the dried pedicels, administered intraperitoneally to mice at a dose of 10.0 mg/kg, was active vs clearance of colloidal carbon[EA0167].

Insecticide activity. Petroleum ether extract of the root was active[EA0100].

Juvenile hormone activity. Ether extract of the root, at variable concentrations, was active on *Oncopeltus fasciatus* and *Tenebrio molitor* pupae[EA0162]. A concentration of 500.0 mcg/animal, applied externally, was active on *Oncopeltus fasciatus*[EA0116].

Larvicidal activity. Acetone extract of the dried root was active on *Culex quinquefasciatus*, LD_{50} 16.0 ppm[EA0182].

Mitogenic activity. Water extract of the dried root was active on the mouse splenocytes[EA0120].

Mutagenic activity. Ethanol (25%) extract of the root, on agar plate at a concentration of 400.0 microliters/disc, was active on *Salmonella typhimurium* TA100 and TA98. Metabolic activation had no effect on the results[EA0130].

Phagocytosis rate increase. Polysaccharide fraction of the dried entire plant, at a concentration of 10.0 mcg/ml, was active on the adult polymorphonuclear leukocytes[EA0166].

Phagocytosis stimulation. Ethanol (95%) extract of the dried root, at a concentration of 0.001%, produced weak activity. When administered intragastrically to mice, a dose of 1.7 mg/kg 3 times daily for 2 days was active vs carbon clearance test[EA0151]. The lyophilized extract, at a concentration of 0.32 mg/gm, was active on the rat liver, results significant at $p < 0.05$ level[EA0169]. Ethanol (95%) extract of the dried root, administered orally to mice, was active vs clearance of colloidal carbon[EA0170]. Ethanol (95%) extract of the entire plant, at a concentration of 0.08% in cell culture, was active on polymorphonuclear leukocytes[EA0134]. Ethanol/water (1:1) extract of the fresh root, administered intraperitoneally to mice at a dose of 50.0 mg/kg, was active[EA0137].

Potassium depletion. Lyophilized extract of the dried root, at a concentration of 0.32 mg/gm, was inactive on the rat liver. The preparation contained a mixture of *Echinacea purpurea, Echinacea angustifolia, Babtisia tinctoria,* and *Thuja occidentalis*[EA0169].

Skin sensitization. Extract of the entire plant, at a concentration of 10.0%, was equivocal when applied externally to the adult. The investigators stated that they were not absolutely sure that the sensitization response was due to the extract. In preparing the extract, some unknown additional materials such as preservatives might have been used[EA0128].

Smooth muscle relaxant activity. Tincture of the entire plant was active on the rabbit's intestine and urinary bladder[EA0102].

Toxic effect. Ethanol (95%) extract of the root, taken orally by adult females at a dose of 5.0 ml, caused anaphylaxis. It was possibly cross-reactivity with other structurally similar allergens. Five percent of the patients with atopy showed hypersensitivity with *Echinacea*[EA0124].

Uterine relaxation effect. Tincture of the entire plant produced weak activity on nonpregnant rabbit uterus[EA0102].

Wound healing acceleration. Water extract of the entire plant was effective on the adult when applied externally. A review in 1965 stated that echinacin, an aqueous extract prepared from *E. purpurea, E. pallida* and/or *E. angustifolia,* can be used externally for the treatment of skin infections, to stimulate granulation and to stimulate the action of leukocytes[EA0177].

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8 Ephedra sinica

Stapf.

Common Names

Ephedra	USA	Mao-kon	China
Ephedra	Europe	Mao	Japan
Ma-huang	China	Maoh	Japan
Ma Huang	USA	Maou	China
Mahuang	China	Soma	India

BOTANICAL DESCRIPTION

The plant is a 30 cm high lightly branched subshrub with lengthened, cylindrical branches 1 to 2 mm in diameter. It is similar in appearance to horsetail, sometimes twining and often having underground runners. The stem and branches are round with numerous vertical grooves of gray-green or bright green coloring; very small reddish-brown leaves, occasionally reduced to pointed scales, almost always fused at the base to form a sheath. The flowers are small and occasionally reduced to acuminate scales. They are fused in pairs at the base. They are unisexual, usually dioecious and sometimes monoecious. The male inflorescences consist of 2–24 blooms. The involucre is 2-lobed and fused to a tube. The fruit is a red, berry-like false fruit formed from the upper bract.

ORIGIN AND DESCRIPTION

This species grows mainly in Mongolia and the bordering area of China. Other species grow in India.

TRADITIONAL MEDICINAL USES

China. Decoction of the entire plant is taken orally for malaria[ES0125].

India. The unripe fresh fruit juice is taken orally to combat fatigue[ES0160].

Japan. Hot water extract of the root is taken orally as an antiperspirant[ES0149].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Apigenin: Aer[ES0135]
Apigenin-5-0-rhamnoside: Aer[ES0135]
Benzylamine, methyl: Pl[ES0167]
Carveol, dihydro: St[ES0157], EO[ES0172]
Catechin, epi (-): St[ES0131]
Cyclohex-3-ene -1,2,3-trimethyl, l-carboxaldehyde: St[ES0157]
Cyclohex-3-ene,1-acetyl-1,3-dimethyl: EO 5.3%[ES0139]
Cyclohex-3-ene-1-carboxaldehyde: EO[ES0172]
Cyclohex-3-ene-1-methanol alpha,alpha,4-trimethyl: EO 35.0%[ES0139]
Ephedradine A: Rt[ES0149]
Ephedrine: Pl 1.2%[ES0171], Aer 0.18-2.27%[ES0119,ES0145]

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By: Ivan A. Ross Humana Press Inc., Totowa, NJ

Ephedrine (-): Aer 1.6%[ES0109], Pl 0.98%[ES0110]
Ephedrine (DL): Aer[ES0126]
Ephedrine, iso (+): Pl[ES0169]
Ephedrine, iso methyl (+): Pl[ES0169]
Ephedrine, iso nor (+): Pl[ES0169]
Ephedrine, methyl: Aer 310-1340[ES0132], Pl 700[ES0110]
Ephedrine, methyl (+): Aer 0.184%[ES0109]
Ephedrine, methyl (-): Aer 0.11%[ES0128]
Ephedrine, N-methyl: Pl[ES0107]
Ephedrine, N-methyl (-): Aer[ES0126]
Ephedrine, nor-pseudo (+): Aer[ES0126]
Ephedrine, nor: Pl[ES0130], Aer 180-1420[ES0132]
Ephedrine, nor (-): Pl[ES0169], Aer 100-430[ES0128,ES0109]
Ephedrine, nor, pseudo: Aer 0.11%-0.142%[ES0106], Pl[ES0108]
Ephedrine, pseudo: Pl[ES0112], Aer 0.027%-0.963%[ES0106,ES0132]
Ephedrine, pseudo (+): Pl 0.41%[ES0110], Aer 0.13%-0.73%[ES0128,]
Ephedrine, pseudo, methyl: Aer 120[ES0133]
Ephedrine, pseudo, methyl (+): Aer 150[ES0109]
Ephedrine, pseudo, n-methyl (+): Aer[ES0126]
Ephedrine, pseudo, nor: Aer 140[ES0133]
Ephedrine, pseudo, nor (+): Pl[ES0134], Aer 290[ES0109]
Ephedroxane: Aer 10[ES0150]
Epherdrine (-): Aer 0.73%[ES0128]
Fluoride: Aer 3.5[ES0165]
Gallocathechin, epi (-): St[ES0131]
Herbacetin: Aer[ES0135]
Herbacetin, 3-methoxy: Aer[ES0135]
Kaempferol: Aer[ES0135]
Kaempferol rhamnoside: Aer[ES0135]
Ligustrazine: Pl[ES0105], St[ES0157]
Menth-2-en-7-ol, para: EO[ES0172], St[ES0157]
Myrcene: St[ES0157], EO[ES0172]
Oxalic acid: Aer[ES0144]
Pseudoephedrine: Pl[ES0130]
Pseudoephedrine (+): Rh, Lf[ES0129]
Pseudoephedrine, nor: Pl[ES0130]
Pyrazine, 2,3,5,6-tetramethyl: EO[ES0172]
Succinic acid, hydroxy: Aer[ES0144]
Terpinen-4-ol: EO[ES0172], St[ES0157]
Terpineol: Pl[ES0105]
Terpineol, alpha: EO[ES0114], St[ES0157]
Terpineol, alpha (-): EO[ES0172]
Terpineol, beta: St[ES0157], EO 6.5%[ES0139]
Tricin: Aer[ES0135]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient effect. Methanol (70%) extract of the aerial part, administered by gastric intubation to pregnant rats at a dose of 500.0 mg/kg on day 13 of pregnancy, was inactive[ES0154].

Analgesic activity. Decoction of the dried stem, administered intragastrically to mice at a dose of 1.2 gm/kg for 7 days, was inactive vs hot plate method. The decoction was used in a mixture containing *Cinnamomum cassia* bark, *Zingiber officinale* rhizome, *Glycyrrhiza glabra* root, *Ziziphus jujuba* fruit, *Asiasarum* species root, and *Aconitum* species root. A dose of 300.0 mg/kg for 8 days was active vs cold stress-induced hyperalgesia. A dose of 100.0 mg/kg for 22 days was active vs adjuvant-induced hyperalgesia[ES0137]. Hot water extract of the dried aerial part, administered by gastric intubation to mice at a dose of 26.0 ml/animal, was active. The preparation was in combination with *Paeonia albiflora*, *Angelica koreana*, *Angelica dahurica*, *Scutellaria baicalensis*, *Aralia cordata*, *Nepeta japonica*, *Glehnia littoralis*, *Clematis mandshurica*, *Atractylodes japonica*, *Poncirus trifoliata*, *Platycodon grandiflorum*, *Pueraria thunbergiana*, *Cnidium officinale*, *Angelica gigas*, *Cimicifuga heracleifolia* and *Glycyrrhiza uralensis* vs inhibition of acetic acid-induced writhing. Results significant at $p < 0.05$ level[ES0155].

Angiotensin-converting enzyme inhibition. Tannin fraction of the dried aerial part was active, IC_{50} 1.9 mcg/ml[ES0163].

Antibacterial activity. Decoction of the dried entire plant, on agar plate, was active on *Staphylococcus epidermidis*, MIC 1.95 mg/ml; *Staphylococcus aureus*, MIC 3.91 mg/ml; *Bordetella bronchiseptica*, *Micrococcus flavus* and *Proteus vulgaris*, MIC 7.81 mg/ml. The decoction was inactive on *Bacillus subtilis*, MIC 125.0 mg/ml, and produced weak activity on *Klebsiella pneumonia*; *Pseudomonas aeruginosa*; *Salmonella typhi* type 2; *Sarcina lutea*, MIC 15.63 mg/ml; *Bacillus cereus* and

Escherichia coli, MIC 31.25 mg/ml[ES0164]. Decoction of the dried rhizome, on agar plate, was active on *Streptococcus mutans*, MIC 15.6 mg/ml[ES0136]. Ethanol (90%) extract of the dried root, on agar plate at a concentration of 500.0 mg/disc, was inactive on *Bacillus subtilis*, *Escherichia coli*, *Streptococcus aureus* and *Streptococcus faecalis*[ES0153]. Hot water extract of the stem, on agar plate, was inactive on *Escherichia coli* and *Staphylococcus aureus*[ES0101].

Antifungal activity. Water extract of the dried aerial part, at a concentration of 10.0 mg/ml, was active on *Aspergillus niger*[ES0123].

Anti-inflammatory activity. Decoction of the dried stem, administered intragastrically to mice at a dose of 100.0 mg/kg for 22 days, was inactive vs adjuvant-induced arthritis[ES0137]. The decoction was used in a mixture containing *Cinnamomum cassia* bark, *Zingiber officinale* rhizome, *Glycyrrhiza glabra* root, *Ziziphus jujuba* fruit, *Asiasarum* species root, and *Aconitum* species root[ES0137]. Hot water extract of the dried aerial part, administered by gastric intubation to rats at a dose of 26.0 ml/animal, was active. The preparation was in combination with *Paeonia albiflora*, *Angelica koreana*, *Angelica dahurica*, *Scutellaria baicalensis*, *Aralia cordata*, *Nepeta japonica*, *Glehnia littoralis*, *Clematis mandshurica*, *Atractylodes japonica*, *Poncirus trifoliata*, *Platycodon grandiflorum*, *Pueraria thunbergiana*, *Cnidium officinale*, *Angelica gigas*, *Cimicifuga heracleifolia*, and *Glycyrrhiza uralensis* vs inhibition of acetic acid-induced pedal edema. The extract produced weak activity vs inhibition of heat denaturation of serum, results significant at $p < 0.05$ level[ES0155]. Methanol extract of the aerial part, at a concentration of 0.1 mg/ml, produced weak activity on the rat macrophages vs lipopolysaccharide-induced interleukin 8 production[ES0117]. Water extract of the entire plant was inactive in an albumin stabilizing assay[ES0100].

Antimutagenic activity. Hot water extract of the dried aerial part, on agar plate at a concentration of 40.0 mg/plate, was inactive on *Salmonella typhimurium* TA100 and TA98 vs aflatoxin B1-induced mutagenesis[ES0147].

Antipsoriatic activity. Decoction of the dried stem, taken orally by adults at a dose of 20.0 ml/person, was active. The dose was taken in a mixture containing *Iaconitum carmichaeli*, *Ligusdticum wallichii*, *Atractylodes lancea*, *Angelica sinensis*, *Coix lacrymajobi*, *Zaocys dhumnades* and snake slough. Seventy patients with psoriasis were treated twice daily for 3 to 8 weeks and for a further period of 3 weeks if there was no response to the initial treatment. There were 31 cases cured (44.29%) and 32 improved (45.71%). Side effects such as nausea, anorexia, and gastralgiam were observed, as well as a mild decrease in leukocytes[ES0146].

Antitumor activity. Ethanol (90%) extract of the dried root, administered intraperitoneally to mice at a dose of 500.0 mg/kg, was inactive on CA-Ehrlich-ascites, LEUK-SN36 and Sarcoma 180 (ASC)[ES0153].

Antitussive activity. Hot water extract of the dried aerial part, in a mixture containing platycodon, ipecac and ginseng administered by gastric intubation and intraperitoneally to mice, was active, ED_{50} 175.0 mg/kg and 107.0 mg/kg, respectively[ES0170].

Antiviral activity. Hot water extract of the dried stem, in cell culture at a concentration of 0.5 mg/ml, was active on poliovirus 1, inactive on herpes simplex 1 virus and measles virus in vero cells culture[ES0111]. Hot water extract of the dried aerial part, administered intragastrically to female mice at a dose of 300.0 mg/kg, was active on Herpes simplex 1 virus. The extract induced a strong delayed type hypersensitivity response[ES0115]. Water extract of the dried aerial part, in cell culture at a concentration of 10.0%, was inactive on Herpes virus type 2, influenza virus A2 (Mannheim 57) and poliovirus II[ES0159].

Antiyeast activity. Ethanol (90%) extract of the dried root, on agar plate at a concentration of 500.0 mg/disc, was inactive on *Candida albicans*[ES0153].

Barbiturate potentiation. Methanol (75%) extract of the entire plant, administered intraperitoneally to male mice at a dose of 250.0 mg/kg, was inactive[ES0152].

Chromosome aberration induction. Hot water extract of the dried aerial part, administered intraperitoneally to mice, was inactive on the bone marrow vs cyclophosphamide-induced damage[ES0147].

Clastogenic activity. Hot water extract of the dried aerial part, administered intraperitoneally to mice, was inactive on bone marrow vs cyclophosphamide-induced damage[ES0147].

CNS stimulant activity. Infusion of the dried entire plant, taken orally by adults, was active. A case was reported of a healthy individual becoming manic after 2 months consumption of herbal tea. The symptoms disappeared in 3 days after discontinuation[ES0118].

Cyclic AMP phosphodiesterase inhibition. The aerial part, at a concentration of 1.0 mg/ml, produced 70.3% inhibition[ES0138]. The stem, in combination with *Prunus persica* in ratios ranging from 1:1 to 1:5, produced inhibition ranging from 60% to 90%, respectively. *Ephedra sinica* and *Cinnamomum cassia*, in ratios ranging from 1:1 to 1:5, produced inhibition ranging from 80% to 100%. *Ephedra sinica* and *Glycyrrhiza uralensis*, in ratios ranging from 1:1 to 1:5, produced inhibition ranging from 90% to 100%. *Ephedra sinica, Glycyrrhiza uralensis*, and *Cinnamomum cassia* produced 64.1% inhibition. *Ephedra sinica, Glycyrrhiza uralensis* and *Prunus persica* produced 58.2% inhibition[ES0138].

Cytotoxic activity. Acetone, petroleum ether and water extracts of the dried stem, at a concentration of 5.0%, were inactive on CA-Ehrlich-ascites. Inhibitions were 17 mm, 14 mm and 18 mm, respectively. The methanol extract was equivocal; 20 mm inhibition[ES0166]. Benzene extract of the dried aerial part, in cell culture, was active on LEUK-L1210, ED_{50} 10.2 mcg/ml[ES0103]. Water extract of the dried aerial part, in cell culture at a concentration of 10.0%, was inactive on Hela cells[ES0159]. Water extract of the dried root, in cell culture at a concentration of 500.0 mcg/ml, produced weak activity on Ca-Mammary microalveolar[ES0140].

DNA polymerase inhibition. Water extract of the dried entire plant, at a concentration of 340.6 mcg/ml, produced weak activity on Hepatitis B DNA[ES0121].

Glutamate-pyruvate-transaminase inhibition. Water extract of the aerial part, at a concentration of 1.0 mg/ml, was inactive on the rat hepatocytes vs CCl_4-induced hepatotoxicity[ES0104].

Hexosaminidase inhibition. Water extract of the dried entire plant, in cell culture, inhibited the release of B-hexosaminidase from the rat RBL-2H3 cells[ES0112].

Histamine release inhibition. Hot water extract of the dried aerial part, at a concentration of 25.0 mg/ml, was inactive on the rat mast cells vs inhibition of histamine release induced by concanavalin A and by compound 48/80[ES0158].

Hypertensive activity. The total alkaloids of the dried entire plant, administered intravenously to dogs at a dose of 1.0 gm/animal, were active[ES0168].

Hypotensive activity. Hot water[ES0151] and methanol[ES0149] extracts of the root, administered intravenously to rats, were active.

Macrophage migration stimulation. Hot water extract of the dried aerial part was active on guinea pigs[ES0162].

Mutagenic activity. Water and methanol extracts of the entire plant, on agar plate at a concentration of 100.0 mg/ml, was inactive on *Bacillus subtilis* H-17 (Rec+) and *Salmonella typhimurium* TA100 and TA98. Metabolic activation had no effect on the results[ES0156]. Water extract of the dried aerial part, on agar plate at a concentration of 50.0 mg/ml, was inactive on *Salmonella typhimurium* TA1535. Metabolic activation had no effect on the results[ES0143].

Plant growth inhibition. Hot water extract of the aerial part, at a concentration of 2.0 gm/liter, was equivocal. The number of fronds of *Lemna paucicostata* >1 mm in length was 96% of controls[ES0141].

Plant root growth stimulant. Hot water extract of the aerial part, at a concentration of 2.0 gm/liter, was active. The root length in *Brassica rapa* was 134% of control[ES0141]. Hot water extract of the aerial part, at a concentration of 2.0 gm/liter, was equivocal on *Cucumis sativus*. The number of roots greater than 5 mm in length was 171% of control[ES0141].

Superoxide dismutase stimulation. Ethanol (95%) extract of the aerial part, administered intragastrically to mice at a dose of 2.0 gm/kg, was inactive. A dose of 1.5 gm/kg, administered intraperitoneally to mice, was active[ES0127].

Teratogenic activity. Methanol (70%) extract of the aerial part, administered by gastric intubation to pregnant rats at a dose of 500.0 mg/kg on day 13 of pregnancy, was inactive[ES0154].

Toxic effect. Water extract of the dried aerial part, administered intraperitoneally to mice, produced weak activity. The mild toxicity was similar to ephedrine. A dose of 8.0 gm/kg, administered by gastric intubation to mice, was inactive[ES0170].

Toxicity assessment. Ethanol (90%) extract of the dried root, administered intraperitoneally to mice, produced LD_{50} 1.0 gm/kg [ES0153]. Methanol (70%) extract of the aerial part, administered by gastric intubation to mice, produced MLD >2 gm/kg[ES0154]. Water and hot water extracts of the dried aerial part, administered intraperitoneally to mice, produced LD_{50} 689.0 mg/kg[ES0145] and 650.0 mg/kg[ES0170], respectively.

Tyrosinase inhibition. Methanol extract of the dried entire plant, at a concentration of 167.0 mcg/ml, was active[ES0113].

Xanthine oxidase inhibition. Ethanol (95%) extract of the aerial part, at a concentration of 15.0 mcg/ml, was active[ES0127].

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9 Eucalyptus globulus

Labill.

Common Names

Alcanfor	Mexico	Eucalyptus	Australia
Calipso	Italy	Eucalyptus	France
Caliptus	Spain	Eucalyptus	Guyana
Ecualipto	Peru	Eucalyptus	Philippines
El ban	Sudan	Eucalyptus	West Indies
Eucalipto blanco	Canary Islands	Gigante	Mexico
Eucalipto	Bolivia	Gum tree	USA
Eucalipto	Brazil	Gum tree	West Indies
Eucalipto	Canary Is.	Kalatus	Tunisia
Eucalipto	Guatemala	Nuholani	Hawaii
Eucalipto	Italy	Plaepiwa	Hawaii
Eucalipto	Mexico	Pulukamu	Tonga
Eucaliptus	Spain	Yukari	Tunisia
Eucalyptus	Tunisia		

BOTANICAL DESCRIPTION

A small to large tree of the MYRTACEAE family that secretes resinous gums, and often has flaky bark. The leaves are simple, opposite, coriaceous, variously shaped and sized, sometimes aromatic. The flowers are axillary of terminal panicles or subumbels. The calyx consists of a calyptra covering the flower bud, corolla absent, stamens numerous and often white, and the ovary inferior. The fruit is a woody capsule opening by means of slits.

ORIGIN AND DISTRIBUTION

The genus *Eucalyptus* consists of about 600 species, most of which are native to Australia. Many are now introduced throughout the tropical and warm-temperate regions of the world.

TRADITIONAL MEDICINAL USES

Bolivia. Infusion of the dried leaf is taken orally as an expectorant for coughs and respiratory congestion. The extract is also used externally to kill fleas[EG0202].

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China. Hot water extract of the dried entire plant is used externally to promote eschar formation in burn treatment[EG0213].

France. Hot water extract of the leaf is taken orally as a hypoglycemic[EG0143].

Guatemala. Decoction of the leaf is taken orally for fever[EG0160]. Hot water extract of the dried leaf is used externally for ringworm, fungal skin diseases[EG0183], wounds, ulcers, bruises and sores, pimples and pustules, as a douche for vaginitis and leucorrhea, and as a wash for infections of the skin and mucosa[EG0218]. The extract is taken orally for diabetes, as a febrifuge and sudorific, and for kidney diseases[EG0217].

India. The leaf essential oil is used externally as a mosquito repellant and an insecticide[EG0223].

Italy. Infusion of the dried leaf is used in inhalation therapy to treat bronchial asthma, and is taken orally as a cholagogue and to treat diabetes[EG0162]. The hot water extract is taken orally for inflammations[EG0174].

Kenya. The fresh and the dried leaf are used to control snail infestation[EG0196].

Mexico. Hot water extract of the dried leaf is taken orally as an antigrippe medication, for urethritis, laryngitis, cystitis, pyelonephritis, gastritis, enteritis, bronchitis, as an antimalarial and antipyretic. The extract is used externally as an antiseptic[EG0204].

Mexico. Infusion of the shade-dried leaf is taken orally to treat infectious diseases[EG0131].

Peru. Decoction of the twig is taken orally for pulmonary ailments and colds[EG0163].

Spain. Essential oil of the fruit and leaf are used in inhalation therapy for the treatment of colds and catarrh. The decoction is taken orally for catarrh[EG0150]. Hot water extract of the leaf is taken orally for diabetes[EG0136].

Tunisia. Hot water extract of the dried leaf is taken orally for bronchial conditions and coughs. Externally, it is used as a mouthwash for dental pain[EG0203].

USA. Hot water extract of the leaf is taken orally as a stimulating expectorant[L00715].

West Indies. Hot water extract of the leaf is taken orally for asthma and diabetes[EG0199].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Alkanes (C-23 to C-31): Lf Wax[EG0124]
Amyrin, beta: Wood 9.3[EG0122]
Apigenin: Lf[EG0139]
Aromadendrene: Lf EO 0.86-3.6%[EG0177,EG0151], Fr EO[EG0147], Twig 2.0%[EG0146]
Aromadendrene, allo: Fr EO 23.3%[EG0185], Lf EO 0.2-0.8%[EG0177,EG0151], Twig 0.6%[EG0146]
Aromadendrene, alpha: Fr EO[EG0188]
Aromadendrin, 3-methoxy: Resin[EG0157]
Aromadendrin, 7-methoxy: Resin[EG0157]
Benzoquinone, para 2,6-dimethoxy: Bk[EG0122]
Betulic acid methyl ester: Wood 14.1[EG0122]
Betulinic acid, acetyl: Wood[EG0122]
Bicostol: Lf EO[EG0117]
Borneol: Fr EO[EG0147], Lf EO 0.2%[EG0151], Twig w/Lf 0.3%[EG0146]
Borneol acetate: Fr EO[EG0147]
Bulnesene, alpha: Fr EO 5.95%[EG0185]
Cadinene, delta: Lf EO[EG0126]
Cadinene, gamma: Lf EO 0.1%[EG0151], Fr EO[EG0188]
Calyptoside: Lf[EG0143]
Camphene: Fr EO[EG0147], Lf EO 0.51%[EG0177]
Caproic acid: Fr EO[EG0147]
Caryophyllene: Lf EO 16.7%[EG0141]
Caryophyllene oxide: Lf EO 0.3%[EG0151]
Catechin (+): Lf[T14766]
Cedrene, beta: Lf EO[EG0127]
Chrysin: Lf[EG0193]
Cineol, 1-8: Lf EO 23.6-64.5%[EG0141,EG0178], Fr EO 20.81-72.5%[EG0185,EG0172], Twig w/Lf 72.8%[EG0146]
Citral: Fr EO[EG0147]
Citronellal: Lf EO[EG0185]
Citronellol: Lf EO 13.6%[EG0141]
Copaene, alpha: Lf EO 0.2%[EG0151]
Cryptone: Lf EO 8.6-16.7%[EG0141]
Cubebene, beta: 0.1%[EG0141]
Cymene, para: Lf EO 0.5-14.6%[EG0177,EG0153]
Daugosterol: Wood 6.1[EG0122]
Ellagic acid: Lf[EG0138,EG0139]
Ellagitannin: Lf[EG0139]

Eremophilene: Fr EO[NO1115]
Erythrodiol: Wood 10.1[EG0122]
Eucalyptin: Lf [EG0193]
Eucalyptin, 8-demethyl: Lf [EG0193]
Eucalyptone: Lf 27.4[EG0121,EG0120]
Eucalyptus globulus substance EK: Bud 0.43%[EG0192]
Eudesmol: Fr EO[EG0147]
Eudesmol, alpha: Lf EO 1.7%[EG0151]
Eudesmol, beta: Lf EO 1.3%[EG0151]
Eudesmol, gamma: Lf EO 0.6%[EG0151]
Euglobal I-A-I: Bud[EG0195,EG0191]
Euglobal I-A-2: Bud[EG0195,EG0191]
Euglobal I-B: Bud[EG0195,EG0191], Lf[EG0210]
Euglobal I-C: Lf[EG0210], Bud[EG0195,EG0191]
Euglobal II-A: Bud[EG0195,EG0191], Lf[EG0210]
Euglobal II-B: Bud[EG0195,EG0191]
Euglobal II-C: Bud[EG0195,EG0191]
Euglobal III: Lf 10, Bud 100[EG0190]
Euglobal IV: Bud[EG0191]
Euglobal IV-A: Lf[EG0194]
Euglobal IV-B: Lf[EG0194]
Euglobal V: Bud[EG0191]
Euglobal VII: Bud[EG0191]
Farnesol, cis-trans: Fr EO 9.95%[EG0185]
Fenchone: Fr EO[EG0147]
Fenchone, iso: Lf EO 0.38%[EG0177]
Gallic acid: Lf[EG0139]
Geraniol: EO[EG0173]
Geraniol acetate: EO[EG0173]
Globulol: Fr EO[EG0188], Twig w/Lf 1.3%[EG0146], Lf EO 1.3-3.44%[EG0151,EG0177]
Globulol, epi: Lf EO[L02117]
Guaiene, alpha: Fr EO 3.15%[EG0185]
Gurjunene, alpha: Fr EO[EG0188], Lf EO 0.6%[EG0151]
Hexane, iso-propyl: Lf EO[EG0141]
Hyperoside: Lf [EG0142]
Isoamyl alcohol: Fr EO[EG0147]
Ledol: Lf EO[L02117], Twig w/Lf 0.2%[EG0146]
Limonene: Lf EO 3.1-5.2%[EG0177,EG0178]
Limonene (+): Lf EO[EG0110]
Linalool: Twig w/Lf 0.2%[EG0146], Lf EO 0.2%[EG0151]
Linalool acetate: Lf EO 1.8%[EG0141]
Linalool oxide: Lf EO 1.9%[EG0141], Fr EO[EG0188]
Linoleic acid: Fr Fixed Oil[EG0123]
Luteolin: Lf [EG0139]
Macrocarpal A: Lf 109[EG0121], Calyx 280[EG0119]
Macrocarpal B: Lf 13[EG0121], Calyx 180[EG0119]
Macrocarpal C: Lf 229[EG0121], Calyx 430[EG0119]
Macrocarpal D: Lf 18.2[EG0121], Calyx 250[EG0119]
Macrocarpal E: Calyx 150[EG0119]
Macrocarpal H: Lf 23.0[EG0121]
Macrocarpal I: Lf 23.0[EG0121]
Macrocarpal J: Lf 28.4[EG0121]
Maslinic acid: Lf[EG0170]
Menthane, para: Fr EO[EG0147]
Myrcene: Fr EO[EG0147], Lf EO 0.1%[EG0151], Twig w/Lf 0.5%[EG0146]
Myristic acid: Fr fixed oil[EG0147]
Myrtenol: Fr EO[EG0147]
Ocimene, beta trans: Lf EO 0.1%[EG0151]
Oleanolic acid: Lf[EG0170]
Oleanolic acid, acetyl: Wood[EG0122]
Oleanolic acid, para-methoxy-cis-cinnamoyl: Wood 2.7[EG0122]
Oleic acid: Fr fixed oil[EG0123]
Palmitic acid: Fr fixed oil[EG0123]
Phellandrene, alpha: Lf EO 0.1-34.3%[EG0151,EG0153], Fr EO 8.3%[EG0185], Twig w/Lf 0.3%[EG0146]
Phellandrene, alpha (-): Lf EO[T02560]
Phellandrene, beta: Fr EO 3.43%[EG0185], Lf EO 3.6%[EG0141]
Phenol, 2,4,6-trimethoxy: Bk [EG0122]
Phenol, 3,4,5-trimethoxy: Bk[EG0122]
Pinene: Lf[L00715]
Pinene, alpha: Lf EO 0.5- 26.0%[j15237,EG0185], Fr EO 4.09%[EG0185], Twig w/Lf 11.9%[EG0146]
Pinene, beta: Lf EO 0.5%[EG0151] , Fr EO[EG0188], Twig w/Lf 0.7%[EG0146]
Pinocarveol, trans: Lf EO 0.94%[EG0177], Twig w/Lf 1.6%[EG0146], Fr EO[EG0147]
Piperitone; Fr EO[EG0188], Twig w/Lf 0.1%[EG0146]
Proanthocyanidin: Lf[EG0138]
Procyanidin B-2,3-O-galloyl: Lf [EG0171]
Prodelphinidin B-2,3-O-galloyl: Lf [EG0171]
Prodelphinidin B-2,3,3-di-O-galloyl: Lf [EG0171]
Prodelphinidin B-5: Lf[EG0171]
Prodelphinidin B-5,3,3-di-O-galloyl: Lf[EG0171]
Pulegole, iso: Lf EO 0.2%[EG0141]
Quercetin: Lf[EG0142]

Quercitrin: Lf[EG0139]
Quercitrin, iso: Lf[EG0142]
Rutin: Lf[EG0142]
Sabinene: Fr EO[EG0147]
Sakuranetin: Resin[EG0157]
Scyllitol: Lf[EG0224]
Selinene, alpha: Lf EO 0.2%[EG0151]
Sideroxylin: Lf[EG0193]
Sideroxylin, 8-demethyl: Lf[EG0193]
Styrene alpha para-demethyl: twig w/Lf 0.3%[EG0146]
Terpin-1-en-4-ol: EO 0.1%[EG0173]
Terpinen-4-ol: Fr EO[EG0188], Lf EO0.8%[EG0151], Twig w/Lf 0.3%[EG0146]
Terpinene, alpha: Fr EO[EG0188]
Terpinene, beta: Fe EO[EG0188]
Terpinene, gamma: Lf EO 0.1-8.9%[EG0151,EG0153], Fr EO[EG0188]
Terpineol, alpha: Lf EO 2.9-5.8%[EG0141,EG0151], Fr EO[EG0147]
Terpineol, alpha acetate: Lf EO 2.09%[EG0177], twig w/Lf 2.7%[EG0146]
Terpinolene: Lf EO 0.1-0.5%[EG0151,EG0141]
Thujone, alpha: Fr EO[EG0147]
Thujone, beta: Fr EO[EG0147]
Thymol: Fr EO[EG0147]
Tocopherol, alpha: Lf 333[K16666]
Tritriacontan-16,18-dione: Lf Wax[M14832]
Tritriacontan-18-one, 16-hydroxy: 7.5[EG0116]
Tritriacontane-16,18-dione, 4-hydroxy: Lf 6[EG0116]
Ursolic acid: Wood 8.1[EG0122]
Ursolic acid, acetyl: Wood 48.8[EG0122]
Ursolic acid, para-methoxy-cis-cinnamoyl: Wood 3.3[EG0122]
Ursolic acid, para-methoxy-trans-cinnamoyl: Wood 4.2[EG0122]
Uvaol: Wood 12.8[EG0122]
Valeraldehyde: Lf[L00715]
Verbenol, trans: Fr EO[EG0147]
Verbenone: Fr EO[EG0147], Twig w/Lf 0.1%[EG0146]
Viridiflorol: Lf EO[L02117]
Vomifoliol: Bk[EG0122]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient effect. The leaf essential oil, administered subcutaneously to pregnant mice at a dose of 135.0 mg/kg on days 6–15 of gestation, was inactive[EG0219].

ACTH-induction. The dried leaf, in the ration of opossum at variable concentrations, was inactive[EG0107].

Analgesic activity. The essential oil was applied on the forehead and temple areas of 32 healthy adults in a double-blind, placebo-controlled, randomized cross-over study. Four different test preparations were applied to large areas of the forehead and temples using a small sponge. The effects were then evaluated by comparing baseline and treatment results. The combination of peppermint oil, eucalyptus oil, and ethanol increased cognitive performance and had a muscle-relaxing and mentally relaxing effect, but had little influence on pain sensitivity. A significant analgesic effect with a reduction in sensitivity to headache was produced by a combination of peppermint oil and ethanol[EG0161]. The leaf essential oil was applied externally with alcohol to 32 volunteers in a randomized, double-blind, placebo-controlled study. The effect was described as muscularly and mentally relaxing, but not analgesic[EG0158].

Anthelmintic activity. Ether extract of the leaf was active on *Strongyloides atercoralis*[EG0222].

Antiamoebic activity. The essential oil, in broth culture at a concentration of 4.0 microliters/ml, was active on *Entamoeba histolytica*[EG0155].

Antiancylostomiasis activity. Ether extract of the leaf was active on *Ancylostoma caninum* and *Ancylostoma duodenale*[EG0222].

Antibacterial activity. Ethanol (50%) extract of the dried aerial part, in broth culture at a concentration of 25.0 mcg/ml, was active on *Staphylococcus aureus*[EG0209]. Methanol extract of the shade-dried leaf, on agar plate at a concentration of 0.6 mg/ml, was inactive on *Staphylococcus aureus*. A concentration of 10.0 mg/ml was inactive on *Escherichia coli* and *Pseudomonas aeruginosa*[EG0131]. The chromatographic fraction of the dried leaf, on agar plate at variable concentrations, was active on several gram-

positive organisms[A11407]. The fresh essential oil, on agar plate, was active on *Pseudomonas aeruginosa* and *Staphylococcus aureus*, and inactive on *Bacillus cereus* and *Escherichia coli*[EG0201]. Water extract of the leaf, on agar plate, was active on *Escherichia coli*, MIC 0.07; *Staphylococcus aureus*, MIC 0.09; *Staphylococcus aureus* strain Oxford, MIC 0.4; *Bacillus subtilis*, MIC 0.8 and *Enterococcus faecalis*, MIC 1.3 mg/ml[EG0166]. The leaf essential oil, on agar plate, was inactive on *Propionibacterium acnes*[EG0125]. The leaf essential oil, on agar plate at a concentration of 6.0 microliters/disc, was active on *Enterobacter* species, *Escherichia coli*, *Haemophilus influenza*, *Klebsiella* species, *Proteus mirabilis*, *Proteus morganii*, *Proteus rettgeri*, *Pseudomonas* species, *Salmonella typhi*, *Salmonella wien*, *Staphylococcus aureus*, *Streptococcus* species and *Pseudomonas aeruginosa*[EG0176]. The leaf essential oil on agar plate, was active on *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*[EG0212]. The leaf essential oil, on agar plate, was active on *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*, and inactive on *Bacillus cereus*[EG0215]. Tincture of the dried leaf (10 gm of plant material in 100 ml ethanol), on agar plate at a concentration of 30.0 microliters/disc, produced weak activity on *Escherichia coli*[EG0218].

Antibacteriophage activity. Ethanol (70%) extract of the fresh leaf, in broth culture, was active on Bacteriophage T2, T4, Type I, MS2, PHI-X0174 and T-7[EG0159].

Antifungal activity. Aqueous low-speed supernatant of the fresh leaf, in broth culture at a concentration of 100.0 ml/liter, produced strong activity on *Hendersonula toruloidea*[EG0206]. Hot water extract of the dried leaf, in broth culture, was inactive on *Epidermophyton floccosum*, *Microsporum canis*, and *Trichophyton mentagrophytes* var. granulare and algodonosa[EG0183]. The fresh essential oil, on agar plate, was inactive on *Penicillium cyclopium*, *Trichoderma viride*, and *Aspergillus aegyptiacus*[EG0201]. The leaf essential oil, on agar plate, produced strong activity on *Aspergillus aegyptiacus*, *Penicillium cyclopium* and *Trichoderma viride*[EG0215]. The leaf essential oil, on agar plate, was active on *Aspergillus flavus*, and produced weak activity on *Keratinomyces ajelloi*, *Microsporum gypseum*, *Trichophyton equinum*, *Trichophyton mentagrophytes*, *Trichophyton rubrum*, and *Trichophyton terrestris*[EG0214]. The leaf essential oil, on agar plate, was active on *Monila sitophila*, *Trichophyton tonsurans*, and *Penicillium digitatum*[EG0141]. The leaf essential oil, on agar plate, was inactive on *Trichophyton mentagrophytes*[EG0125].

Antihyperglycemic activity. Hot water extract of the dried leaf, in the ration of mice at a dose of 6.25% of the diet with the addition of decoction 1 gm/400 ml of drinking water, was active vs Streptozotocin-induced hyperglycemia[EG0180]. Infusion of the dried leaf, taken orally by adults at variable dosage levels, was inactive[EG0108]. Water extract of the dried leaf, administered intragastrically to mice, was active[EG0136]. Water extract of the dried leaf, administered by gastric intubation and intraperitoneally to mice, produced weak activity vs alloxan-induced hyperglycemia[EG0204]. The ethanol (95%) extract, administered by gastric intubation to rabbits at a dose of 1.0 gm/kg, was inactive[EG0115].

Anti-inflammatory activity. Decoction of the dried seed was active vs croton oil-induced edema in mice and vs cotton pellet granuloma and carrageenin-induced pedal edema in the rat[EG0129]. Ethanol (80%) extract of the dried leaf, administered by gastric intubation to male rats at a dose of 100.0 mg/kg, produced 18% inhibition of edema vs carrageenin-induced pedal edema[EG0174].

Antimalarial activity. Chloroform extract of the twig, administered orally to chicken at a dose of 264.0 mg/kg, and the water extract at a dose of 3.48 gm/kg, were inactive on *Plasmodium gallinaceum*[EG0101]. Ethanol

(95%) extract of the dried aerial part, at a concentration of 100.0 mcg/ml, produced weak activity on *Plasmodium falciparum* FMN-17, MP-II and SO. A concentration of 150.0 mcg/ml produced weak activity on *P. falciparum* FAN-5. A concentration of 75.0 mcg/ml was active on *P. falciparum* FMN-13[EG0220]. Hexane extract of the dried leaf, administered intragastrically to mice at a dose of 100.0 mg/kg daily for 4 days, was inactive on *Plasmodium berghei*[EG0144].

Antimutagenic activity. Methanol extracts of the dried fruit and leaf, on agar plate at a concentration of 50.0 microliters/disc, were inactive on *Bacillus subtilis* NIG-1125 His Met and *Escherichia coli* B/R-WP2-TRP[EG0205]. Infusion of the leaf, on agar plate at a concentration of 100.0 microliters/disc, was inactive on *Salmonella typhimurium* TA100 vs ethyl methanesulfonate-induced mutagenicity and on *Salmonella typhimurium* TA98 vs 2-amino-anthracene-induced mutagenicity. Metabolic activation was not required for the activity[EG0165]. Methanol extract of the dried leaf, on agar plate at a concentration of 50.0 microliters/disc, was inactive on *Bacillus subtilis* NIG-1125 His Met and *Escherichia coli* B/R-WP2-TRP[EG0205].

Antimycobacterial activity. Ethanol (95%) extract[EG0114] and fluid extract[EG0103] of the dried leaf, on agar plate, were active on *Mycobacterium tuberculosis*. The activity was lost in the presence of whole blood. The water extract was inactive[EG0114]. The leaf essential oil, administered intramuscularly to guinea pigs at a dose of 500.0 mg/kg, was active on *Mycobacterium tuberculosis*. The treatment enhances the activities of sulfetrone 100 mg/kg, streptomycin 2 mg/kg, and isoniazid 10.0 mg/kg, administered orally[EG0113].

Antioxidant activity. Hexane and methanol extracts of the dried leaf were equivocal[EG0145].

Antitumor activity. Ethanol (50%) extract of the dried aerial part, administered intraperitoneally to mice at a dose of 140.0 mg/kg, was inactive on LEUK-P388[EG0209].

Antiviral activity. Water extract of the dried leaf, in cell culture at a concentration of 10.0%, was active on Influenza virus, Vaccinia virus and Poliovirus II, and produced strong activity on Herpes virus type 2[EG0207].

Antiyeast activity. Methanol (50%) extract of the dried leaf, on agar plate, was active on *Candida albicans*[EG0221]. The tincture (10 gm of plant material in 100 ml ethanol), on agar plate at a concentration of 30.0 microliters/disc, produced weak activity[EG0218]. Methanol extract of the shade-dried leaf, on agar plate at a concentration of 1.25 mg/ml, was inactive on *Candida albicans*[EG0131]. The leaf essential oil, on agar plate, was inactive on *Pityrosperum ovale*[EG0125]. The leaf essential oil, on agar plate, was active on *Candida albicans*[EG0212] and *Cryptococcus neoformans*[EG0154].

Cardiovascular effect. Ethanol (50%) extract of the dried aerial part, administered intravenously to dogs at a dose of 25.0 mg/kg, was active[EG0209].

CNS effect. The essential oil was applied on the forehead and temple areas of 32 healthy adults in a double-blind, placebo-controlled, randomized cross-over study. Four different test preparations were applied to large areas of the forehead and temples using a small sponge. The effects were then evaluated by comparing baseline and treatment results. The combination of peppermint oil, eucalyptus oil and ethanol increased cognitive performance and had a muscle-relaxing and mentally relaxing effect, but had little influence on pain sensitivity. A significant analgesic effect with a reduction in sensitivity to headache was produced by a combination of peppermint oil and ethanol[EG0161].

Cutaneous absorption effect. The leaf essential oil, applied to the abdomen of mice at a concentration of 0.25%, was active when measured 2 hours after application[EG0111].

Cytotoxic activity. Ethanol (50%) extract of the dried aerial part, in cell culture at a concentration of 25.0 mcg/ml, was inactive

on CA-9KB[EG0209]. Water extract of the dried leaf, in cell culture at a concentration of 10.0%, produced weak activity on Hela cells[EG0207].

Diuretic activity. Decoction of the dried leaf, administered nasogastrically to rats at a dose of 1.0 gm/kg, was active[EG0217].

Estrogenic effect. The leaf essential oil, administered subcutaneously to ovariectomized mice, was inactive. The treatment was effective on immature female rats. The activity was equivalent to 10 units/ml[EG0100].

Expectorant activity. The leaf essential oil, administered orally to cats and rabbits at a dose of 100.0 mg/kg, produced weak activity, was active in rats and inactive in dogs. A dose of 50.0 mg/kg was active in guinea pigs[EG0104].

Hypertensive activity. The chromatographic fraction of the dried leaf, administered intravenously to rabbits at variable dosage levels, was inactive[A011407].

Hypotensive activity. The chromatographic fraction of the dried leaf, administered intravenously to rabbits at variable dosage levels, was inactive[A011407].

Insect repellent activity. The leaf essential oil (12 part), in a mixture of pennyroyal oil (24 part), cedar oil (6 part), citronella oil (6 part) and rue oil (1.5 part) formulated (2-7%) in an organic solvent, paraffin wax, petrolatum, soap, and cotton rope was effective for fleas on dogs[EG0200]. The leaf essential oil was active on *Pediculus humanus humanus*[EG0164].

Insecticide activity. The leaf essential oil, at a concentration of 0.8%, was active on mites (Pyroglyphidae)[EG0148]. The leaf essential oil, at a concentration of 0.002%, in a mixture containing 0.01% *Ocimum sanctum* essential oil and 0.002% *Ocimum basilicum* essential oil, produced 100% mortality on *Culex fatigans* larvae[EG0208].

Larvicidal activity. The essential oil, at a concentration of 25.0 ppm, was active on the *Anopheles stephensi* larvae[EG0216].

Molluscicidal activity. Water extracts of the dried and fresh leaf, at a concentration of 1:500, were active on *Ancylostoma ceylanicum*, *Biophalaria* species, *Bulinus* species, and *Physopsis* species[EG0196].

Mutagenic activity. Tincture of the leaf, on agar plate at a concentration of 80.0 microliters/disc, was inactive on *Salmonella typhimurium* TA100 and TA98. Metabolic activation had no effect on the results[EG0152].

Radical scavenging effect. Ethanol (50%) extract of the dried entire plant, at a concentration of 5.0 mcg/ml, produced weak activity vs superoxide anion, estimated by the neotetrazolium method[EG0156].

Repellent activity. Methanol extract of the dried leaf, at a concentration of 4.0 mg/square cm, was equivocal on *Mytilus edulis*[EG0118].

Rubefacient effect. The leaf essential oil was applied externally with alcohol to 32 volunteers in a randomized, double-blind, placebo-controlled study. The effect was described as muscularly and mentally relaxing but not analgesic[EG0158].

Teratogenic activity. The leaf essential oil, administered subcutaneously to pregnant mice at a dose of 135.0 mg/kg on days 6 to 15 of gestation, was inactive[EG0219].

Toxic effect. Fatalities have been reported after the ingestion of doses between 4 and 480 ml of the essential oil. Toxic symptoms include gastrointestinal pain, vomiting, diarrhea, CNS depression, coma, miosis, seizure (usually in children), feeling of suffocation and muscular weakness. Treatment is supportive and may include gastric lavage and charcoal[EG0181]. The chromatographic fraction of the dried leaf, administered subcutaneously to rabbits at a dose of 0.2 mg/kg daily for 2 weeks, was inactive[A011407]. The leaf essential oil, in the bath water, produced burning, redness and irritation on the skin of a child. When taken orally by an adult, vomiting, mild CNS depression, apnea and cardiac arrythmias were observed[EG0182]. The leaf essential oil, taken orally by a

child at a dose of 10 to 15 ml, produced symptoms that included pallidity, lethargy, coolness of the skin and dyspnea[EG0149].

Toxicity assessment. Ethanol (50%) extract of the dried aerial part, when administered intraperitoneally to mice, produced an LD_{50} 562.0 mg/kg[EG0209]. The leaf essential oil, when administered intragastrically to mice, produced an LD_{50} 3.32 gm/kg[EG0175]. The leaf essential oil, when administered orally to rats, produced LD_{50} 4.44 gm/kg[EG0198].

Tyrosine inhibition. The dried aerial part, in cell culture at a concentration of 500.0 mcg/ml, was inactive on melanoma-B16[EG0134].

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10 Ginkgo biloba

L.

Common Names

Eun-haeng	Korea	Ityo	Japan
Ginkgo tree	USA	Maiden hair tree	China
Ginkgo nut	Japan	Maiden hair tree	Germany
Ginkgo	Iran	Maiden hair tree	India
Ginkgo	Japan	Maiden hair tree	Iran
Ginkgo	Korea	Maiden hair tree	Japan
Ginkyo	Japan	Maiden hair tree	Korea
Ginnan	Japan	Maiden hair tree	USA
Gin-nan	Japan	Zhanco	Iran
Icho	Japan		

BOTANICAL DESCRIPTION

Gingko biloba is a 30 to 40 m high dioecious tree of the CYCADACEAE family, with a girth of about 4 meters. The trees can live for hundreds of years. The bark is light to dark brown with rough grooves and reticulate fissures. The leaves are fan-shaped with bifurcated ribs, fresh green and golden yellow in autumn. The tree flowers for the first time when it is between 20 to 30 years old. The flowers are dioecious. They are in the axils of the lower leaves of the annual growth. The male flowering parts are attached to short catkins. The female flowers have longer pedicles and are at the end of a leafless branch. Fertilization occurs months after pollination by spermatozoids, although usually only one ovule is fully formed. The seeds later become fleshy and plum-like round and light green or yellow in color. They have a diameter of about 2.5–3 cm and contain a two-edged edible nut. They smell like butyric, capric or valeric acid when ripe.

ORIGIN AND DISTRIBUTION

Indigenous to China, Japan and Korea, it is now grown in Europe.

TRADITIONAL MEDICINAL USES

China. The fruit pulp is macerated in vegetable oil, and after 100 days it is taken orally for pulmonary tuberculosis[GB0236]. Hot water extract of the fruit is taken as an anthelmintic[GB0339]. Hot water extract of the leaf is taken orally as a vermifuge, and for asthma and senility[GB0213]. The raw seeds are

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eaten, and the decoction of the seed is taken orally for cancer. The pan-fried seeds are eaten for tuberculosis[GB0236].

Iran. Hot water extract of the dried leaf is taken orally for vision disturbances associated with blood circulation abnormalities and inflammation, and to improve memory loss associated with blood circulation abnormalities. The ethanol (90% and 95%) extracts are taken orally as an arterial dilator and arterial circulation stimulator[GB0123].

Korea. Hot water extract of the fruit is taken orally for its oxytocic effect[GB0109].

South Korea. Hot water extract of the seed is taken orally to induce labor[GB0336] and as an abortifacient[GB0324].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Acacetin: Lf[GB0322]
Acenaphthene: EO[GB0318]
Acetic acid: Pollen[GB0311]
Afzelin: Pollen 141[GB0315]
Amentoflavone: Lf 3.8-5[GB0263,GB0295]
Anacardic acid: Pl[GB0126]
Apigenin: Lf[GB0146], Pollen 109[GB0315]
Arabinitol,2-carboxy: Lf 18 nmol/gm[GB0209]
Arachidic acid: Pollen[GB0315]
Ascorbic acid: Fr 640[GB0340], Lf[GB0100]
Astragalin: Lf 1.8%[GB0261]
Atlantone,(E): Heartwood[GB0124]
Atlantone,(Z): Heartwood[GB0124]
Atlantone,10,11-dhydro,(Z): Heartwood[GB0124]
Atlantone,10,11-dihydro,(E): Heartwood[GB0124]
Atlantone,10,11-dihydro-6-oxo,(E): Heartwood[GB0124]
Auroxanthin: Chloroplast[GB0264]
Behenic acid: Pollen[GB0315]
Benzene,1,4-dimethyl-2,5-diisopropyl: EO[GB0318]
Benzoic acid,4-hydroxy: Lf [GB0322]
Betulaprenol 15: Lf[GB0206]
Betulaprenol 16: Lf[GB0206]
Betulaprenol 17: Lf[GB0206]
Betulaprenol 18: Lf[GB0206]
Betulaprenol 19: Lf[GB0206]
Betulaprenol 20: Lf[GB0206]
Betulaprenol 21: Lf[GB0206]
Bilobalide A: Lf[GB0105]
Bilobalide: Lf 330[GB0169], Pl[GB0185]
Bilobanone: Lf[GB0242], Heartwood[GB0124]
Bilobetin,1-5-methoxy: Testa[GB0136]
Bilobetin,5-methoxy: Lf 2[GB0314]
Bilobetin: Lf 0.0025%-1.9%[GB0107,GB0285]
Bilobol: Fr[GB0154]
Campesterol: Kernel[GB0320]
Cardanol: Testa[GB0328]
Carotene,alpha: Chloroplast[GB0264]
Carotene,beta: Lf[GB0189]
Carotene,gamma: Chloroplast[GB0264]
Catechin,(+): Lf[GB0100], Call Tiss[GB0243]
Catechin,epi,(-): Lf[GB0100]
Catechin,epi-gallo,(-): Lf[GB0101]
Catechol,(+): Lf[GB0242]
Catechol,epi,(-): Lf[GB0242]
Catechol,epi-gallo,(-): Lf[GB0242]
Catechol,gallo,(+): Lf[GB0242]
Choline: Lf[GB0242]
Citric acid: Pollen[GB0311]
Cosmosiin: Lf[GB0146]
Coumaric acid,para: Pollen 47[GB0315]
Coumarin,iso,8-hydroxy-3-(6-pentadecenyl)-3,4-dihydro: Fr[GB0121]
Coumarin,iso,8-hydroxy-3-heptadecyl-3,4-dihydro: Fr[GB0121]
Coumarin,iso,8-hydroxy-3-tridecyl-3,4-dihydro: Fr[GB0121]
Cymene,para: EO[GB0318]
Cystathionine: Fr 0.16[GB0343]
Daucosterol: Lf[GB0100]
Diphenol,4,4-(penta-cis-1-cis-5-diene-1,5-diynyl): Lf 22.7[GB0117]
Docosan-1-ol: Pollen 445[GB0315]
Dolichol: Lf[GB0281]
Elemol: Heartwood[GB0124]
Ergosterol: Sd[GB0338]
Eudesmol,beta: Heartwood[GB0124]
Eudesmol,gamma: Heartwood[GB0124]
Flavonoids: Lf[GB0308]
Flavoxanthin: Chloroplast[GB0264]
Formic acid: Pollen[GB0311]
Galactocerebroside: Lf[GB0229]
Gallocatechin,(+): Lf[GB0101]
Gingolide C: Lf[GB0282]
Ginkgetin,iso: Lf 21-2900[GB0107,GB0217]
Ginkgetin: Lf 42-6530[GB0107,GB0217]
Ginkgo biloba polyprenol 14: Lf[GB0321]
Ginkgo biloba polyprenol 15: Lf[GB0321]
Ginkgo biloba polyprenol 16: Lf[GB0321]
Ginkgo biloba polyprenol 17: Lf[GB0321]

Ginkgo biloba polyprenol 18: Lf[GB0321]
Ginkgo biloba polyprenol 19: Lf[GB0321]
Ginkgo biloba polyprenol 20: Lf[GB0321]
Ginkgo biloba polyprenol 21: Lf[GB0321]
Ginkgo biloba polyprenol 22: Lf[GB0321]
Ginkgo flavone glycosides: Lf[GB0199]
Ginkgo polyprenol 15: Lf[GB0163]
Ginkgo polyprenol 16: Lf[GB0163]
Ginkgo polyprenol 17: Lf[GB0163]
Ginkgo polyprenol 18: Lf[GB0163]
Ginkgo polyprenol 19: Lf[GB0163]
Ginkgo polyprenol 20: Lf[GB0163]
Ginkgo polyprenol 21: Lf[GB0163]
Ginkgo polyprenol 22: Lf[GB0163]
Ginkgo polyprenol 85: Lf[GB0163]
Ginkgo polyprenol 90: Lf[GB0163]
Ginkgo polyprenol 95: Lf[GB0163]
Ginkgo polyprenol 120: Lf[GB0163]
Ginkgo polysaccharide GF-1: Lf[GB0119]
Ginkgo polysaccharide GF-2-A: Lf[GB0119]
Ginkgo polysaccharide GF-2-B: Lf[GB0119]
Ginkgo polysaccharide GF-3: Lf[GB0119]
Ginkgoic acid,hydro: Endosperm[GB0130]
Ginkgoic acid: Fr[GB0154]
Ginkgol: Lf[GB0317], Endosperm[GB0130]
Ginkgolic acid,dihydro: Fr[GB0173]
Ginkgolic acid,hydro: Lf[GB0173]
Ginkgolic acid: Fr[GB0173], Lf <50[GB0229]
Ginkgolide A: Rt Bk 100[GB0114], Lf 4-220[GB0111,GB0169], Call Tiss[GB0137], Pl[GB0185]
Ginkgolide B: Rt Bk 100[GB0114], Pl[GB0329], Lf 50-2500[GB0111,GB0176]
Ginkgolide C: Pl[GB0185]
Ginkgolide C: Pl[GB0329], Lf 0.75-120[GB0111,GB0169], Rt Bk 200[GB0114]
Ginkgolide J: Lf 540[GB0164], Call Tiss[GB0137], Rt[GB0156]
Ginkgolide M: Rt Bk 0.2[GB0114]
Ginkgotoxin: Sd 100[GB0118], Lf[GB0232]
Ginnol: Lf 1260[GB0162], Pollen 463[GB0315], Fr[GB0154]
Ginnone: Lf[GB0100]
Glycerol,DL-threo-para-hydroxy-phenyl: Lf[GB0122]
Glycerol,threo-guaiacyl,DL: Lf[GB0122]
Heptacosane,N: Lf 38.1%[GB0162]
Heptadeca-3,6,9-trien-1-ol: EO[GB0318]
Hexacosan-1-ol: Lf[GB0100]
Hexadecanoic acid,14-methyl: Sd Oil[GB0231]
Hex-cis-3-en-1-ol: EO[GB0318]
Hex-cis-4-en-1-ol: EO[GB0318]
Hexen-1-al: Lf[GB0100]
Hex-trans-2-en-1-al: Lf[GB0113]
Hex-trans-4-en-1-ol: EO[GB0318]
Ingnoceric acid: Pollen[GB0315]
Ionone,beta: EO[GB0318]
Kaempferol: Lf[GB0112]
Kaempferol-2,6-dirhamnosyl glucoside: Lf[GB0276]
Kaempferol-3-0-(2,0-[6,0-{para-(beta-D-glucosyl)-oxy-trans-cinnamoyl}-beta-D-glucosyl]-alpha-L-rhamnoside): Lf[GB0146]
Kaempferol-3-0-(2,6-di-0-rhamnopyranosyl-glucopyranoside): Lf[GB0202]
Kaempferol-3-0-(2,6-dirhamnopyranosyl-beta-D-glucopyranoside): Lf 22[GB0295]
Kaempferol-3-0-(2-0-beta-D-glucopyranosyl)-alpha-L-rhamnopyranoside: Lf 5.3[GB0120]
Kaempferol-3-0-(6-para-coumaroyl-glucopyranosyl-beta-1,4-rhamnopyranoside): Lf[GB0288]
Kaempferol-3-0-(6-para-coumaroyl-glucosyl(1,2))rhamnoside: Lf[GB0296]
Kaempferol-3-0-[2,0-6-0-(para-hydroxy-trans-cinnamoyl)-beta-D-glucosyl]-alpha-L-rhamnoside: Lf[GB0146]
Kaempferol-3-0-[2-0-(beta-D-glucosyl)-alpha-L-rhamnoside]: Lf[GB0146]
Kaempferol-3-0-[2-0-6-0-{para-(7-0-beta-D-glucopyranosyl)-coumaroyl}-beta-D-glucopyranosyl]-alpha-L-rhamnopyranoside: Lf 3.1[GB0120]
Kaempferol-3-0-[2-0-6-0-bis-(alpha-L-rhamnosyl)-beta-D-glucoside]: Lf[GB0146]
Kaempferol-3-0-[3-para-coumaroyl-glucosyl-beta(1,4)-rhamnoside]: Lf 2.5%[GB0261]
Kaempferol-3-0-[6,0-para-coumaroyl-beta-D-glucopyranosyl(1,2)]-alpha-L-rhamnopyranoside: Lf 200[GB0295]
Kaempferol-3-0-[6-0-alpha-L-rhamnosyl)beta-D-glucoside]: Lf[GB0146]
Kaempferol-3-0-[6-0-para-coumaroyl-beta-D-glucosyl-(1,2)-alpha-L-rhamnoside]: Lf[GB0276]
Kaempferol-3-0-[alpha-rhamnosyl-(,2)-alpha-rhamnosyl-(1,6)]-beta-D-glucoside: Lf 1.2%[GB0261]
Kaempferol-3-0-[alpha-rhamnosyl(1,2)alpha-rhamnosyl(1,6)]beta-D-glucoside: Lf 700[GB0266]

Kaempferol-3-0-[beta-D-glucopyranosyl(1,2)]-alpha-L-rhamnopyranoside: Lf[GB0122]
Kaempferol-3-0-alpha-(6-para-coumaroyl-glucosyl-beta-1-4-rhamnoside): Lf[GB0221]
Kaempferol-3-0-alpha-(6-para-coumaroyl-glucosyl-beta-1-4-rhamnoside): Lf 47[GB0262]
Kaempferol-3-0-alpha-L-[beta-D-glucopyranosyl(1,2)rhamnopyranoside]: Lf[GB0161]
Kaempferol-3-0-alpha-L-rhamno-glucoside: Lf 580[GB0104]
Kaempferol-3-0-alpha-L-rhamnoside: Lf[GB0146]
Kaempferol-3-0-beta-D-rutinoside: Lf 0.1%[GB0313]
Kaempferol-3-0-coumaroyl-glucorhamnoside: Lf[GB0174]
Kaempferol-3-0-para-coumaroyl-glucorhamnoside: Lf[GB0178]
Kaempferol-3-0-rhamnosyl (1,2)rhamnosyl(1,6)glucoside: Lf[GB0296]
Kaempferol-3-0-rutinoside: Lf 40-130[GB0262,GB0295]
Kaempferol-coumaroyl-glucorhamnoside: Lf[GB0286]
Kynurenic acid,6-hydroxy: Lf 20-966[GB0262,GB0245]
Lactic acid: Pollen[GB0311]
Laricitrin-3-0-rutinoside: Lf[GB0295]
Lauric acid: Pollen[GB0315]
Legumin-like protein (Ginkgo biloba): Sd[GB0265]
Linalool oxide, trans: EO[GB0318]
Linoleic acid: Lf, Kernel 44.5%[GB0310]
Linolenic acid, alpha: Lf[GB0125]
Linolenic acid: Fr, Lf[GB0173]
Lutein ester: Lf[GB0189]
Lutein,5-6-epoxy: Chloroplast[GB0264]
Lutein: Lf[GB0189]
Luteolin: Lf[GB0146]
Luteolin-3-0-beta-D-glucoside: Lf[GB0146]
Malic acid: Pollen[GB0311]
Myricetin,3-0-methyl-H 3-0-alpha-L-rhamnoside: Lf 305[GB0313]
Myricetin,3-methyl 3-0-(6-0-alpha-L-rhamnosyl)-beta-D-glucoside: Lf[GB0146]
Myricetin: Lf[GB0146]
Myricetin-3-0-[6-0-(alpha-L-rhamnosyl)-beta-D-glucoside]: Lf[GB0146]
Myristic acid: Pollen[GB0315]
Naphthalene,dihydro 2,5,8-trimethyl: EO[GB0318]
Neoxanthin,cis: Chloroplast[GB0264]
Neoxanthin,trans: Chloroplast[GB0264]
Neoxanthin: Lf[GB0189]
Octacosan-1-ol: Lf[GB0100]
Octadeca-5,9,12-trienoic acid: Sd Oil[GB0231]
Octadeca-5,9-dienoic acid: Sd Oil[GB0231]
Octadecasphingadiene,n-alphahydroxy-palmitoyl-glucosyl: Sd[GB0312]
Oleic acid: Kernel 37.5%, Lf[GB0310]
Palmitic acid.alpha-hydroxy: Sd, Kernel[GB0312]
Pentacosane,n: Lf 17.4%, Kernel[GB0162]
Phenol,2-isopropyl: EO[GB0318]
Pinitol,(+): Pollen 76[GB0315]
Pinitol: Lf[GB0242]
Plamitic acid: Lf 25.1%, Kernel[GB0310], Fr[GB0173], Pollen[GB0315]
Populnin: Lf 1.5[GB0262], Pollen 119[GB0315]
Proanthocyanidin: Lf 4.12%[GB0143]
Prodelphinidin: Lf[GB0242]
Propylene,para-tolyl: EO[GB0318]
Protein H(Ginkgo biloba): Sd[GB0265]
Protocathechuic acid: Lf[GB0248]
Pyridoxine,4-0-methyl: Sd[GB0175]
Pyridoxine,4-methoxy: Sd 100[GB0116]
Pyridoxine,4-methyl: Lf, Sd[GB0232]
Pyruvic acid: Pollen[GB0311]
Quercetin: Lf 24[GB0179]
Quercetin-3-0-(2,6-di-0-rhamnopyranosyl-glucopyranoside): Lf[GB0202]
Quercetin-3-0-(2-0-beta-D-glucopyranosyl)-alpha-L-rhamnopyranoside: Lf 2.8[GB0120]
Quercetin-3-0-(6-0-para-coumaroyl-beta-D-glucopyranosyl(1,2)alpha-L-rhamnopyranoside): Lf[GB0295]
Quercetin-3-0-(6-para-coumaroyl)glucosyl(1,2)rhamnoside): Lf[GB0296]
Quercetin-3-0-(6-para-coumaroyl-glucopyranosyl-beta-1,4-rhamnopyranoside): Lf[GB0288]
Quercetin-3-0-(6-para-coumaroyl-glucosyl-beta(1,4)-rhamnoside: Lf 2.1%[GB0261]
Quercetin-3-0-(alpha-rhamnosyl-(1,2)-alpha-rhamnosyl-(1,6)-beta-glucoside: Lf 0.8%[GB0261]

Quercetin-3-0-(alpha-rhamnosyl(1,2)alpha-rhamnosyl(1,6)beta-glucoside: Lf 700[GB0266]
Quercetin-3-0-[2-0-(6-0-para-hydroxy-cinnamoyl)-beta-D-glucosyl]-alpha-L-rhamnoside: Lf[GB0146]
Quercetin-3-0-[2-0-(6-0-parahydroxy-trans-cinnamoyl)-beta-D-glucosyl]-alpha-L-rhamnoside: Lf[GB0146]
Quercetin-3-0-[2-0-6-0-{para-(7-0-beta-D-glucopyranosyl}-coumaroyl)-beta-D-glu-co pyranosyl}-coumaroyl)-beta-D-gluco-pyranosyl]alpha-L-rhamnopyranoside: Lf 4.4[GB0120]
Quercetin-3-0-[2-0-6-0-bis(alpha-L-rhamnosyl)-beta-D-glucoside]: Lf[GB0146]
Quercetin-3-0-[2-0-6-0-para-coumaroyl)-beta-D-glucopyranosyl]-alpha-L-rhamnopyranosyl-7-0-beta-D-glucopyranoside: Lf 40[GB0120]
Quercetin-3-0-[2-0-beta-D-glucosyl)-alpha-L-rhamnoside: Lf[GB0146]
Quercetin-3-0-[6-0-alpha-L-rhamnosyl]-beta-D-glucoside: Lf[GB0146]
Quercetin-3-0-[6-0-para-beta-D-glucosyl]-oxy-trans-cinnamoyl-beta-D-glucosy-alpha-L-rhamnoside: Lf[GB0146]
Quercetin-3-0-[6-0-para-coumaroyl-trans-cinnamoyl)-beta-D-glucosyl-alpha-L-rhamnoside: Lf [GB0276]
Quercetin-3-0-alpha-(6-para-coumaroyl-glucosyl-beta-1,2-rhamnoside): Lf[GB0221]
Quercetin-3-0-alpha-(6-para-coumaroyl-glucosyl-beta-1,4-rhamnoside): Lf 20[GB0262]
Quercetin-3-0-alpha-(6-para-coumaroyl-glycosyl-beta-1,4-rhamnoside): Lf 20[GB0246]
Quercetin-3-0-alpha-L-rhamno-glucoside: Lf[GB0100]
Quercetin-3-0-coumaroyl-glucorhamnoside: Lf[GB0174]
Quercetin-3-0-para-coumaroyl-glucorhamnoside: Lf[GB0178]
Quercetin-3-0-rhamnosyl(1,2) rhamnosyl(1,6)glucoside: Lf[GB0296]
Quercitrin,iso: Lf 0.5[GB0262]
Quercitrin: Lf 0.5[GB0262]
Quinic acid: Lf[GB0100]
Resorcyclic acid,6-(pentadec-8-enyl): Sd[GB0155]
Resorcyclic acid,6-(tridec-8-enyl): Sd[GB0155]
Rhamnetin,iso 3-0-[2-0-6-0-bis(alpha-L-rhamnosyl)-beta-D-glucoside]: Lf[GB0146]
Rhamnetin,iso 3-0-[6-0-alpha-L-rhamnosyl)-beta-D-glucoside: Lf[GB0146]
Rhamnetin,iso 3-0-beta-D-glucoside: Lf[GB0146]
Rhamnetin,iso 3-0-beta-D-rutinoside: Lf 625[GB0313]
Rhamnetin,iso 3-0-rutinoside: Lf 2.0%[GB0261]
Rhamnetin,iso: Lf[GB0112]
Rhamnetol,iso 3-0-rutinoside: Lf 2[GB0262]
Rutin: Lf 6-940[GB0262,GB0179]
Salicylic acid,6-heptadeca-cis-9-cis-12-dienyl: Lf 500[GB0220]
Salicylic acid,6-heptadecadienyl: Lf [GB0173]
Salicylic acid,6heptadec-cis-8-enyl: Lf 0.44%[GB0220]
Salicylic acid,6-heptadecenyl: Lf, Fr[GB0173]
Salicylic acid,6-heptadecenyl: Lf[GB0247]
Salicylic acid,6-pentadec-cis-8-enyl: Lf 1.2%[GB0220]
Salicylic acid,6-pentadec-cis-enyl: Fr, Lf[GB0173]
Salicylic acid,6-pentadecenyl: Lf[GB0247]
Salicylic acid,6-pentadecyl: Lf[GB0173]
Salicylic acid,6-tridecyl: Fr[GB0173]
Salicylic acid,6-tridecyl: Lf 400[GB0220]
Salicylic acid,6-tridecyl: Lf[GB0173]
Salicylic acid,n-heptadecenyl: Fr, Lf[GB0151]
Salicylic acid,n-heptadecyl: Lf, Fr[GB0151]
Salicylic acid,n-pentadecenyl: Lf, Fr[GB0151]
Salicylic acid,n-pentadecyl: Lf, Fr[GB0151]
Salicylic acid,n-tridecyl: Lf, Fr[GB0151]
Sciadopitysin: Lf 33-78[GB0107,GB0295]
Sequoyitol: Lf[GB0100], Pollen 31[GB0315]
Sesamin,(+): Heartwood[A07572]
Shikimic acid: Lf[GB0100]
Sitosterol,beta: Lf[GB0102], Pollen[GB0315], Sd[GB0338]
Stearic acid: Pollen[GB0315]
Stogmasterol: Pollen[GB0315], Lf[GB0102]
Succinic acid: Pollen[GB0311]
Syringetin-3-0-rutinoside: Lf 1.4[GB0262]
Thymol: EO[GB0318]
Tocopherol,gamma: Lf 140[GB0162]
Tricosane,n: Lf 12.5%[GB0162]
Vanillic acid: Lf[GB0248]
Violaxanthin,cis: Chloroplast[GB0264]
Violaxanthin,trans: Chloroplast[GB0264]
Violaxanthin: Lf[GB0189]
Zeaxanthin: Chloroplast[GB0264]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Acetylglucoseamidase inhibition. The dried leaf extract, administered intravenously to rats at a dose of 2.0 mg/kg, was active on the intestine vs ligation-induced ischemia[GB0272].

Adaptogenic activity. The flavonoid fraction of the dried leaf, administered intraperitoneally to rats at a dose of 50.0 mg/kg, was active on animals subjected to the stress of being bound in a 5 degrees Celsius and 428 mm Hg environment. The time until colonic temperature had fallen to 23 degrees Celsius and the time to recovery once the animals were removed to normal environment (32 deg. Celsius and 1 ATM) were recorded. When the treatment was given 34 minutes prior to the test, recovery was significantly reduced. When the animals were dosed for 5 days, the time to attain 23 degrees Celsius was increased and the recovery time was decreased significantly[GB0293].

Adrenergic agonist (beta). Ethanol (95%) extract of the dried leaf, administered intraperitoneally to mice at a dose of 100.0 mg/kg, was active. The extract exerts a specific effect on the noradrenergic system and on Beta-receptors. No variation was found in alpha-2 receptors or serotonin uptake[GB0254].

AIDS therapeutic effect. Ethanol (30%) extract of the leaf, in a mixture containing flavopereirine, dihydro-flavopereirine, naringin and naringenin, taken orally by adults, was effective. The biological activity has been patented[GB0157].

Allergenic activity. The fruit, taken orally by male adults at a dose of 2 fruits/person, produced erythrema, burning and swelling of the mouth, tenesmus, perirectal burning and pruritis ani [GB0127].

Analgesic activity. Ethanol (30%) extract of the dried leaf, administered by intravenous infusion to adult patients with diabetes mellitus who had hyperpathic polyneuropathy syndrome, showed a decrease in symptoms. The biological activity has been patented[GB0297].

Antiaging activity. Ethanol (30%) extract of the dried leaf was effective vs aging-induced changes in mitochondrial morphology and function[GB0138].

Antiallergenic activity. Hydro-alcoholic extract of the dried leaf, at a concentration of 0.1%, was effective in a double-blind, placebo-controlled study of 22 females with contact dermatitis. After pretreatment of the skin with the extract, 68% of the subjects showed significantly reduced skin reactivity as compared with the placebo[GB0147].

Antiatherosclerotic activity. Ethanol (30%) extract of the dried leaf, administered intragastrically to rabbits receiving a high fat diet at a dose of 10.0 mg/kg daily, was effective[GB0227].

Antibacterial activity. Hot water extract of the leaf, on agar plate at a concentration of 1.2 mg/disc, was inactive on *Streptococcus mutans* strains MT5091 and OMZ176. The methanol extract, at a concentration of 0.2 mg/disc, was active on strain MT5091. A concentration of 0.8 mg/disc was active on OMZ176. Methanol/water (1:1) extract, at a dose of 1.2 mg/disc, was active on strains MT5091 and OMZ176[GB0331]. Water extract of the leaf, on agar plate, was active on *Staphylococcus aureus*, MIC 10.5 mg/ml[GB0239].

Anticerebral edema activity. Ethanol (30%) extract of the dried leaf, administered intraperitoneally to rats at a dose of 5.0 mg/kg daily for 21 days, increased binding density of labeled 8-hydroxy-2(di-n-propylamino)tetralin to 5-HT-1A receptors in aged animals[GB0181]. Ethanol (95%) extract of the dried leaf, at a dose of 0.2 gm/person, was administered either orally or by intravenous infusion to women with idiopathic cyclic edema. Full correction of the biological anomaly resulted in the 5 patients treated by the intravenous infusion, and in

10 patients treated by oral administration. Landis' test was performed before and after the oral treatment[GB0260]. The intravenous infusion of the extract, at a dose of 100.0 mg/person, was effective on patients with vasogenic edema observed after irradiation of the brain[GB0258].

Anticlastogenic activity. Ethanol (30%) extract of the dried leaf, at a concentration of 100.0 mcg/ml, was effective when tested on culture exposed to clastogenic factors from plasma of persons exposed to irradiation[GB0198]. A dose of 40.0 mg/day, 3 times daily for 2 months, was effective when taken orally by recovery workers from the Chernobyl accident[GB0219].

Anticytotoxic activity. Ethanol (30%) extract of the dried leaf, administered intragastrically to mice at a dose of 200.0 mg/kg, was active on pancreatic beta cells vs alloxan-induced cytotoxicity[GB0180].

Antideafness activity. Ethanol (95%) extract of the dried leaf was taken orally by adults with acute cochlear deafness. At the conclusion of the double-blind therapeutic trial comparing the extract and a standard alpha-blocker (nicergoline), a significant recovery was observed in both therapeutic groups. Improvement was distinctly better in the extract-treated group[GB0256].

Antidementia activity. Ethanol (30%) extract of the dried leaf was taken orally by 202 patients with Alzheimer's or multi-infarct dementia. Significant improvement was seen in the Alzheimer's biological activity disease assessment scale and a geriatric evaluation by Relative's rating instrument, but not in clinical global impression of change[GB0134]. When the extract was taken orally by 12 healthy volunteers, EEG data indicated increased alpha activity[GB0211]. The ethanol (95%) extract, administered intraperitoneally to rats and orally to healthy volunteers at variable dosage levels, was effective in 4 studies using electroencephalograms to measure the effects[GB0267]. The effectiveness of the ethanol (95%) extract of the dried leaf, taken orally by adults of both sexes in the treatment of cerebral disorders due to aging, was evaluated. In the double-blind, drug vs placebo trial involving 166 patients, a specially devised geriatric clinical evaluation scale was used. The results confirmed that the extract is effective against cerebral disorders due to aging. The difference between control and treatment groups became significant at 3 months and increased during the following months[GB0259]. The dried leaf was taken orally by adults at a dose of 150.0 mg/kg, in a study to test the effect on improvement of well being and cerebral functional capacity. The randomized, double-blind, placebo-controlled trial with 50 patients with degenerative and vascular dementia lasted for 13 weeks. Three tablets of 50.0 mg of extract each or 3 placebo tablets were given daily. Adverse side effects were seen under placebo treatment once and under active treatment twice. Significant differences between the groups were seen in 7 of 11 patients after 12 weeks. The active treatment group was significantly faster in carrying out the Figure Connection Test after 6 and 12 weeks. The results indicate a significant improvement in cerebral functional capacity in the patients with degenerative and vascular dementia[GB0289]. Ethanol (30%) extract of the leaf, taken orally by adults at a dose of 150.0 mg/day, was effective. Fifty patients aged from 57 to 76 years with cerebro-organic syndrome, participated in a placebo-controlled, double-blind study. After a washout phase of 14 days, the therapy began with the intake of a 50 mg coated tablet 3 times daily. The therapeutic efficacy was tested with the Vienna Determination test, the Figure Connection test, Saccadic eye movement, EEG analysis, and measurement of the evoked potentials. For all 5 target criteria, a statistically highly significant superiority of active treatment

was shown in comparison to the placebo group, which appeared after only 3 weeks of treatment and became more obvious after 6 weeks. At the same time the clinical symptoms improved, the results indicated that therapy with the extract in patients with cerebro-organic syndrome contributes to an increased cerebral capacity[GB0299]. This dose was also active in patients after a subarachnoid hemorrhage and aneurysm operation. Without treatment, even after 7–42 months they had serious cognitive deficits and only 70% of them would have good neuropsychological results. A placebo-controlled, double-blind study was conducted with 50 outpatients after SAH and an aneurysm operation. After 12 weeks of treatment with the extract, significant improvements were shown in the field of attention and verbal short-term memory[GB0304]. In a placebo-controlled, double-blind study, the efficacy of the extract on cerebral functional capacity and well-being was studied in 52 ambulant patients with vascular dementia over a period of 3 months. The dose in this case was a drinking solution equivalent to 150.0 mg of the leaf extract. A strong placebo effect was observed. At a total study period of 2 years, the stability of the solution was possibly not sufficient. The effectiveness was equivocal[GB0302].

Antiedema activity. Ethanol (30%) extract of the dried leaf, administered intragastrically to rats at a dose of 100.0 mg/kg immediately after the induction of cerebral lipid deoxidation and edema by bromethalin, was effective[GB0307]. The extract also decreased the water, sodium and potassium levels vs triethyltin-induced cerebral edema[GB0273]. Methanol extract of the fruit, at a dose of 2.0 mg/ear, was effective on the mouse vs 12-0-tetradecanoylphorbol-13-acetate (TPA)-induced ear inflammation. The inhibition ratio was 10[GB0170].

Antiemetic activity. Ethanol (30%) extract of the dried leaf was administered intragastrically to rats at a dose of 50.0 mg/kg, in a mixture of 50% ginger, 20% extract and 30% water. The results showed blocked lithium chloride-induced conditioned place aversion, indicating antiemetic activity comparable to metoclopramide[GB0210].

Antifungal activity. Ether extract of the fresh bud, on agar plate, was active on *Aspergillus fumigatus*[GB0332].

Antihyperglycemic activity. Ethanol (30%) extract of the dried leaf, administered intragastrically to male rats at a dose of 50.0 mg/kg, produced weak activity vs streptozotocin-induced non-insulin dependent diabetes mellitus[GB0129]. A dose of 80.0 mg/person, taken orally by 7 male volunteers twice daily for 8 weeks, showed no significant change or tendency to change. Differential tests with LHRH and TRH were performed before, and 4 and 8 weeks after the treatment[GB0115].

Antihypoxic effect. Glycoside mixture of the entire plant, taken orally by 8 healthy men in a double-blind, crossover study, demonstrated a hypoxia-protecting effect [GB0330]. Water extract of the dried leaf, administered by gastric intubation to rats at a dose of 200.0 mg/kg for 14 days, did not significantly alter brain energy metabolism, although it had a protective effect. A dose of 100.0 mg/kg, administered intraperitoneally to rats, produced an increase in blood glucose level, a slight lowering of lactate and a lowering of the lactate /pyruvate ratio. There was also a less pronounced breakdown of high-energy phosphates in cases of severe hypoxia. Results significant at $p < 0.001$ level[GB0244].

Antiinflammatory activity. Ethanol (30%) extract of the dried leaf, applied externally on mice, was effective vs croton oil-induced edema[GB0186]. A dose of 80.0 mg/person, taken orally by adults, was effective vs platelet aggregation factor-induced skin wheal and flare[GB0133]. Ten patients, aged 35–75, participated in a study to determine the effect of

the extract on ulcerative colitis. Of the 10 patients, 3 went into remission, 2 experienced some effects and 5 experienced no effect[GB0177].

Antiischemic effect. Ethanol (30%) extract of the dried leaf, at a concentration of 200.0 mg/kg, improved the mechanical recovery and suppressed the leakage of lactate dehydrogenase during reperfusion. It diminished the decrease of ascorbate content and suppressed the increase of dehydroascorbate[GB0191]. When administered intra-arterial to the rabbit at a dose of 10.0 mg/kg, the extract inhibited the increase in lipid peroxidation and superoxide dismutase vs ischemia/reperfusion-injury[GB0194]. Intragastric administration to rats was effective vs chloroquine-induced increase in amplitude and delay of B wave on electroretinogram, indicative of retinopathy[GB0195]. A dose of 50.0 mg/kg, administered intragastrically to rats, reduced reperfusion-induced increases in tissue Na^+ and Cl^-, and decreased K^+ following ischemia injury in streptozotocin-induced diabetic animals[GB0205]. A dose of 1.0 mg/kg, administered intravenously to dogs, was effective vs embolic stroke-induced cerebral blood flow decreases and oxygen extraction increases[GB0201]. A dose of 100.0 mg/kg, administered intravenously to rats, was not effective vs bilateral carotid obstruction-induced ischemia [GB0212]. A dose of 150.0 mg/person, taken orally by 50 outpatients with degenerative and vascular dementia in a randomized, double-blind, placebo-controlled trial, was found to improve performance on psychometric tests and judgment scales after 6 and 12 weeks[GB0158]. A dose of 10.0 mg/kg, administered subcutaneously to rats, was effective vs middle cerebral artery ligation-induced infarct[GB0212].

Antimutagenic activity. Methanol extract of the dried leaf, on agar plate at a concentration of 50.0 microliters/disc, was inactive on *Bacillus subtilis* NIG-1125 His Met and *Escherichia coli* B/R-WP2-TRP[GB0323].

Antimycobacterial activity. Ethanol (30%) extract of the dried leaf, administered intragastrically to female mice at a dose of 200.0 mg/kg, was inactive on *Mycobacterium avium*[GB0197]. Ethanol (95%) extract of the fresh fruit peel, on agar plate, was active on *Mycobacterium smegmatis*[GB0319]. The fruit, on agar plate, was active on *Mycobacterium tuberculosis*[GB0110]. The leaf juice, on agar plate, produced weak activity on *Mycobacterium tuberculosis*, MIC 1:20[GB0108].

Antineurotoxic activity. Ethanol (30%) extract of the dried leaf, in the drinking water of mice at a dose of 50.0 mg/kg for 7 months, increased the projection field of intra- and infra-pyramidal mossy fibers, and reduced the area of stratum radiatum[GB0187]. The ethanol (95%) extract, administered intragastrically to mice at a dose of 100.0 mg/kg daily for 17 days, prevented a 25% loss of striatal dopaminergic nerve endings seen in control, vs subcutaneously osmopump-released n-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) at a rate of 100 mg/kg/day[GB0279].

Antioxidant activity. Ethanol (30%) extract of the dried cell free extract, at a concentration of 10.0 mcg/ml, was active on neurons vs oxidative stress induced by hydrogen peroxide[GB0237]. Ethanol (30%) extract of the dried leaf, at a concentration of 2-16 mcg/ml, reduced the ability of synaptosomes prepared from striata to take up 3H-dopamine rapidly during incubation at 37 degrees Celsius, in an oxygenated Krebs-Ringer medium with 0.1 mM ascorbic acid. Ascorbic acid was responsible for this decrease. Its effectiveness after a 60 minute incubation was concentration-dependent from 1 mM and virtually complete for 0.1 mM. A decrease of synaptosomal membrane fluidity was revealed by measurements of fluorescence polarization. This decrease was potentiated by Fe^{2+}. In contrast, it was prevented by the Fe^{2+} chelator, deferriozamine (0.1mM), by the extract as well as by the

flavonoid quercetin. This preventative effect was shared by trolox (0.1 mM). It is concluded that peroxidation of neuronal membrane lipids induced by ascorbic acid/ Fe^{2+} is associated with a decrease in membrane fluidity, which in turn reduces the ability of the dopamine transported to take up dopamine[GB0222]. A concentration of 200.0 mg/liter quenches diphenylpicrylhydrazyl in a dose-dependent manner and is able to react with free radicals directly [GB0191]. A concentration of 25.0 mcg/ml had a time- and dose-dependent effect on the red blood cells. A 14.84% inhibition was produced, results significant at $p < 0.01$ level. A dose of 250.0 mcg/ml produced 56.53% inhibition. Results significant at $p < 0.001$ level[GB0192,GB0193]. The ED_{50} of the extract was 6.4 mcg/ml vs photo-induced oxidation of low-density lipoprotein cholesterol[GB0238]. A concentration of 250.0 mcg/ml was active on human red blood cells vs lipid peroxidation induced by hydrogen peroxide[GB0141]. The IC_{50} was 150.0 mcg/ml on liver microsomes vs NADPH, ADP and $FeCl_3$-induced lipoperoxidation, results significant at $p < 0.05$ level[GB0204]. A dose of 100.0 mg/day, administered in the drinking water of male rats, was active on the rat brain and liver mitochondria[GB0142]. Intragastric administration to rats, at a dose of 100.0 mg/kg, was effective on brometha-lin-induced brain lipid peroxidation and cerebral edema[GB0190]. A dose of 150.0 mg/kg reduced LDH activity, decreased mitochondrial lipid peroxide content, decreased mitochondrial phospholipid content and increased reduced glutathione content in ischemia-induced rat brain injury[GB0224]. The leaves, administered orally to male rats, inhibited ischemia-induced lipid peroxidation in animals with experimental spinal cord injury[GB0140]. The dried leaf, at a concentration of 100.0 mcg/ml, was active vs copper-mediated LDL oxidation[GB0208] and inhibited LDL-peroxidation, but delta-tocopherol and beta-carotene levels were maintained[GB0200].

Antiplatelet activity. Ethanol (30%) extract of the dried leaf, at a dose of 60 mg per day for 1.5 years, produced an increase in bleeding time. The dose was taken orally by a 33-year-old woman without significant medical history. She developed bilateral subdural hematomas spontaneously[GB0132].

Antipolydipsia activity. Ethanol (30%) extract of the dried leaf, administered intragastrically to rats at a dose of 100.0 mg/kg, was effective vs stress-induced polydipsia[GB0172].

Antiproteolytic activity. Ethanol (30%) extract of the dried leaf, at a dose of 40.0 mg/kg in the drinking water of rabbits for 3 weeks, had a protective effect on retinal tissue[GB0188].

Antishock effect. Ethanol (95%) extract of the dried leaf, administered by intravenous infusion to adults at a dose of 50.0 mg/person, was effective in a rare but severe case of hypovolemic shock related to monoclonal gammapathy. The treatment resulted in a dramatic recovery, and was followed by oral administration[GB0251].

Antistress activity. Ethanol (30%) extract of the dried leaf, administered intragastrically to rats at a dose of 50.0 mg/kg, was effective on the hippocampus vs chronic cold stress-induced desensitization of serotonin-1A receptors at the adenyl cyclase coupling step[GB0144].

Antithrombotic effect. Ethanol (30%) extract of the dried leaf, administered intragastrically to male rats at a dose of 50.0 mg/kg, was effective vs laser-induced arterial thrombosis. Results significant at $p < 0.05$ level[GB0240]. The 95% ethanol extract, administered intravenously to male guinea pigs at variable dosage levels, was active vs PAF-acether-induced thrombosis[GB0249,GB0250].

Antitinnitus activity. Ethanol (95%) extract of the dried leaf, taken orally by 103 patients in a 13-month treatment period

using a double-blind, drug vs placebo method, improved the condition of all the tinnitus patients, irrespective of the prognostic factors. The results were conclusive as regards the effectiveness of the extract, and it was possible to determine the prognostic value of different parameters of special importance[GB0257].

Antivertigo effect. Ethanol (95%) extract of the dried leaf was used in a study of 70 patients with vertiginous syndrome of recent onset and undetermined origin. In a double-blind trial extending over a 3-month period, the patients were given either the extract or placebo. The effectiveness of the extract on the intensity, frequency and duration of the disorder was statistically significant. At the conclusion of the study, 47% of the patients treated had no more symptoms as compared to 18% of those who received the placebo[GB0255].

Antiviral activity. Hot water extract of the dried fruit, in vero cell cultures at a concentration of 0.5 mg/ml, was inactive on Herpes Simplex 1 virus, measles virus and poliovirus 1[GB0183].

Anxiety induction. Ethanol (30%) extract of the dried leaf, administered intragastrically at a dose of 48.0 mg/kg and intraperitoneally at a dose of 8.0 mg/kg to male rats, decreased the duration of social contact in social interaction test[GB0241].

Anxiolytic effect. Acetone/water (1:1) extract of the dried leaf, administered intragastrically to female rats at a dose of 1.0 mg/kg, was active vs elevated plus-maze test. The 30% ethanol extract, in a mixture with *Zingiber officinale*, was also effective[GB0218].

Apoptosis inhibition. Ethanol (30%) extract of the dried leaf, at a concentration of 100.0 mcg/ml assayed in cerebellar cell culture, was active on neurons vs hydroxyl radical-induced apoptosis[GB0230].

ATP level increased. Ethanol (30%) extract of the dried leaf, at a concentration of 0.5 mcg/ml, was active on the human umbilical vein endothelium vs hypoxia-induced decrease in ATP[GB0214].

Blood viscosity decreased. The leaf juice, taken orally by 30 artherosclerotic patients 3 times daily for over 3 months, was effective. Two out of 3 patients showed a decrease in blood viscosity[GB0277].

Blood viscosity increased. Ethanol (95%) extract of the dried latex, taken orally by adults at a dose of 45.0 ml/person, was not effective[GB0275].

Bradykinin antagonist activity. Flavonoid fraction of the leaf was effective on guinea pig ileum, ED_{50} 75.0 mcg/ml[GB0103].

Cardiovascular effect. Ethanol (95%) extract of the dried leaf, administered orally to 36 patients with arteritis for 65 weeks, was active. For the first 6 months of treatment, the patients participated in a double-blind, randomized comparison with 35 well-matched patients taking a placebo. Subsequently, the patients taking the extract were given the option to continue treatment on an open basis with follow-up at regular 3-month intervals. The patients taking the extract had significantly greater pain relief and walking tolerance than the placebo after 6 months of treatment, and the improvement continued throughout the duration of the study[GB0252].

Cell membrane stabilization. Ethanol (30%) extract of the dried leaf, in cell culture at a concentration of 100.0 mcg/ml, was active on pulmonary artery endothelial cells. The extract inhibited LDH release after pre-incubation of the cells with the extract[GB0223]. The dried fruit was active on the rabbit RBC, ED_{50} 0.2 mg/ml. A dose of 200.0 mg/kg increased the resistance to hemolysis by 54% after 24 hours[GB0316].

Cerebral arteriosclerotic effect. Ethanol (70%) extract of the dried leaf, taken orally by adults in a chewing gum containing the extract, was effective in treating cerebral apoplexy. The biological activity has been patented[GB0139].

Cerebral blood flow effect. Ethanol (30%) extract of the dried leaf, administered intragastrically and intraperitoneally to rats of both sexes at a dose of 100.0 mg/kg for 21 days, showed an increase in blood flow, ATP, glucose and lactate levels as compared to controls. When a dose of 200.0 mg/kg was administered to the animals for 14 days, prior to hypobaric hypoxia, the animals survived the hypoxia for a longer time, but the brain metabolism was not affected[GB0139]. The extract was taken orally at a dose of 300.0 mg/kg by 24 hypertensive patients with fundus hypertonicus phase 1 according to Theil. In the randomized, placebo-controlled, double-blind trial, the influence of the extract on retinal blood flow was measured before and on the 14th and 22nd day of treatment. The daily dose was 3 coated tablets, each containing 100 mg of the extract. In the placebo group, the value did not change considerably. Under Verum treatment, both the blood flow in the quadrant artery and the total blood flow, improved significantly in comparison to the placebo group. The arterio-venous circulation time decreased significantly. Rheological parameters, erythrocyte aggregation and erythrocyte filtration time showed a tendency to decrease, and plasma viscosity demonstrated a significant drop in comparison to placebo[GB0291]. A dose of 150.0 mg/person was tested for the improvement of typical symptoms of cerebral insufficiency in a placebo-controlled, double-blind study. Ninety-nine outpatients with typical symptoms participated in the study that lasted for 12 weeks. The state of health was significantly improved after only 4 weeks. After 12 weeks, 10 of 12 symptoms were clearly improved when compared to the controls[GB0292].

Cerebral blood flow increase. Ethanol (30%) extract of the leaf, administered intravenously to rats at a dose of 50.0 mg/kg, was effective on the ante-positioned arteria mesenterica superior. After the induction of lactate acidosis, the effect was measured in 48 single procedures and registered by means of intravital microscopy. Various methods of application and dosages were tested against control solution. However, it was only at 1 minute after local and 15–22 minutes after intravenous application that significant hemorheologic effects could be seen[GB0305]. A double-blind study of the extract was conducted with 16 volunteers who had signs of cerebral insufficiency in order to prove the pharmacological effects concerning vigilance. An enforced lack of sleep model was used where the topographic aspects of the EEG output could be shown with a special EEG mapping method. After 8 weeks of therapy, the output of the Theta band decreased in the group treated with the extract under enforced lack of sleep, whereas the Alpha slow wave index in the control group increased. The results of the analysis indicated that treatment with the extract influences the EEG frequency spectrum within the sense of increased vigilance[GB0303]. In a placebo-controlled, double-blind study, the efficacy of the extract on cerebral functional capacity and well-being was studied in 52 ambulant patients with vascular dementia over a period of 3 months. The dose in this case was in the drinking solution equivalent to 150.0 mg of the leaf extract. A strong placebo effect was observed. At a total study period of 2 years, the stability of the solution was possibly not sufficient. The effectiveness was equivocal[GB0302].

Cerebral edema decreased. The dried leaf, administered intragastrically to rats at a dose of 100.0 mg/kg, was effective[GB0271].

Cerebral insufficiency improvement. Acetone/water (1:1) extract of the leaf, taken orally by adults at a dose of 160 mg/day, was effective[GB0148]. Ethanol (30%) extract of the

dried leaf, taken orally by adults at a dose of 120.0 mg/person daily for 4–6 weeks, was effective[GB0166]. The efficacy of the extract, at a dose of 150.0 mg/day, was tested in a double-blind trial of 90 patients with cerebral insufficiency. The average age of the patients was 62.7 years. By the end of the 12 week trial period, there was significant improvement in the patients' performance, observed under Verum, compared to the placebo preparation which was administered to a control group of patients among which the relevant disorders were distributed homogeneously. The effect of the extract was stabilization of a more consistent response behavior with minor intraindividual variations involved. There was improvement in the patients' attention with respect to tasks which required quick orientation and readaptation, or a consistent attentiveness level, to be maintained over a longer period of time (long-term stress). The range of optimum attention with respect to the solution of tasks was enlarged as far as the time was concerned. Improvement in memory performance was experienced, particularly with respect to the visual memory of sensitive parameters of cerebral insufficiency, which may also be due to the improvement in concentration power. Positive changes in subjective performance were also found, which were experienced by the patient and the people in his or her environment. Since improvements of some of the parameters were not observed until the 6th week of treatment, the test preparation should be used over a minimum period of time[GB0226].

Chloride channel inhibition. Ethanol (30%) extract of the dried leaf, at a concentration of 50.0 mcg/ml, inhibited isoproterenol-induced chloride current, but no effect was seen on the action potential or associated currents of guinea pig heart[GB0182].

Cholesterol level decrease. The dried leaf, taken orally by adults of both sexes at a dose of 120.0 mg/person in combination with garlic, produced improvement in cholesterol with no dietary or exercise changes[GB0196].

Chronotrophic effect. Ethanol (95%) extract of the dried latex, taken orally by adults at a dose of 45.0 ml/person, was not effective[GB0275]. Ethanol (30%) extract of the dried leaf, taken orally by 10 adult volunteers each with some hemorheological abnormality, was effective. The extract was in combination with *Panax ginseng*. The heart rate was measured 1 hour after the treatment[GB0165].

Circulation stimulation. Ethanol (95%) extract of the dried latex, taken orally by adults at a dose of 45.0 ml/person, was effective[GB0275]. The influence of the dried leaf, at a dose of 112.5 mg/person on cutaneous microcirculation, was studied in a randomized, placebo-controlled, single-blind crossover study of 2 groups. In the first phase of the study, a liquid preparation was tested against a corresponding placebo. In the second phase, a solid preparation was tested compared with the liquid preparation. Blood pressure, heart rate and capillary diameters stayed constant in both tests. A significant increase of capillary erythrocyte velocity was measured 1 hour after administration of the Ginkgo liquid (57%) followed by the Ginkgo tablet (42%). The peak efficiency of both preparations was reached about 1 hour after administration[GB0290].

CNS depressant activity. Ethanol (30%) extract of the dried leaf, administered intraperitoneally to male rats at a dose of 16.0 mg/kg, was not effective on locomotor activity[GB0241].

CNS effects. Ethanol (30%) extract of the dried leaf, administered intragastrically to rats at dose of 10.0 mg/kg, significantly increased the amplitude of spectra analysis of EEG in alloxan-diabetic and extract-treated animals compared to controls[GB0215].

The leaf, taken orally by 36 patients at a dose of 120 mg/day, was effective. The 36 patients with cerebro-organic syndrome (dizziness, memory and concentration loss, and orientation disorders) participated in a double-blind, placebo-controlled study. After 4 to 8 weeks of treatment, the treated group had lower Saccade duration, and better scores on the Wiener determination test and number connection test than the control group. Upon EEG testing, the theta proportion of the theta/alpha ratio was reduced[GB0335].

Corticosteroid synthesis stimulation. Ethanol (30%) extract of the dried leaf, administered intragastrically to male rats at a dose of 100.0 mg/kg, was active vs ACTH-stimulated corticosterone production in adrenocortical cells[GB0145].

Cytochrome P-450 induction. Ethanol (30%) extract of the dried leaf, taken orally by adults at a dose of 400.0 mg/person, was inactive[GB0203].

Cytotoxic activity. Acetone, ether and methanol extracts of the dried seed, at a concentration of 5.0% were inactive by the cylinder plate method, and the water extract was equivocal on CA-Ehrlich ascites. The inhibitions were 16 mm, 17 mm, 0 mm and 25 mm, respectively[GB0341]. Chloroform, water and methanol extracts of the leaf, in cell culture, were inactive on LEUK-P388, ED_{50} 100.0 mcg/ml[GB0228]. Ethanol (30%) extract of the dried leaf, in cell culture at a concentration of 500.0 mcg/ml, was inactive on pulmonary artery endothelial cells [GB0223]. Ethyl acetate extract of the leaf, in cell culture, produced weak activity on HELA-83 cells, IC_{50} 43.0 mcg/ml[GB0233].

Desmutagenic activity. The fresh fruit homogenate, on agar plate at a concentration of 100.0 microliters/disc, was active on *Salmonella typhimurium* TA100 and TA98 vs 1,4-dinitro-2-methyl pyrrole mutagenesis[GB0327].

DNA binding inhibition. The dried leaf, in cell culture at a concentration of 10.0 mcg/ml, was active on Jurkat cells vs AP-1 binding activity in 12-0-tetradecanoylphorbol 13-acetate-treated cells[GB0225].

Dopamine uptake inhibition. Ethanol (30%) extract of the dried leaf, at variable concentrations, was inactive on synaptosomes[GB0167].

Fibrinolytic activity. Ethanol (30%) extract of the dried leaf, administered intra-arterially (left coronary artery) to rabbits at a dose of 10.0 mg/kg, was active vs ischemia/reperfusion-induced decrease in plasminogen activator and increase in plasminogen activator inhibitor[GB0194].

Glucose uptake induction. The dried entire plant, in cell culture at a concentration of 0.25 mcg/ml, was effective on the smooth muscle cells of pig aorta[GB0269].

Glucose uptake inhibition. Ethanol (30%) extract of the dried leaf, at a dose of 50.0 mg/kg administered 1 hour before the administration of radioactive 2-deoxyglucose, produced a decrease in 21 of 38 brain regions, and whole brain glucose utilization declined by 16.1%. Glucose utilization was determined autoradiographically in brain slices[GB0184].

Glucose utilization inhibition. Ethanol (30%) extract of the dried leaf, administered intragastrically to rats at a dose of 50.0 mg/kg, decreased the utilization of glucose in the frontal parietal, somatosensory cortex, nucleus accumbens and pons[GB0207].

Glutamate receptor blocker. The dried leaf, at a concentration of 2.0 mcg/ml, was active on quisqualate and kainate receptors[GB0213].

Glutathione formation induction. Ethanol (30%) extract of the dried leaf, in cell culture at a concentration of 200.0 mcg/ml, was active on pulmonary artery endothelial cells vs tert-butylperoxide-induced glutathione depletion[GB0131].

Glutathione reductase stimulation. Ethanol (30%) extract of the dried leaf, in cell culture at a concentration of 300.0 mcg/ml,

was active on pulmonary artery endothelial cells[GB0131].

Glycogen content increase. Ethanol (30%) extract of the dried leaf, administered intragastrically to male rats at a dose of 50.0 mg/kg, was effective on the gastrocnemius-soleus muscle vs streptozotocin-induced noninsulin dependent diabetes mellitus[GB0129].

Glycogen synthesis stimulation. The dried entire plant, in cell culture at a concentration of 0.25 mcg/ml, was effective on the smooth muscle cells of pig aorta[GB0269].

Hypertensive activity. Ethanol (95%) extract of the dried latex, taken orally by adults at a dose of 45.0 ml/person, was not effective[GB0275].

Immunostimulant activity. Ethanol (95%) extract of the dried latex, taken orally by adults at a dose of 45.0 ml/person, was not effective[GB0275].

Insecticide activity. Water extract of the dried branches and leaves, at variable concentrations, was inactive on *Blatella germanica*. When administered intravenously at a dose of 40.0 ml/kg, the extract was inactive on *Periplaneta americana*[GB0342].

Insulin level increase. Ethanol (30%) extract of the dried leaf, administered intragastrically to male mice at a dose of 50.0 mg/kg, was not effective when measured in the plasma[GB0129].

Insulin release stimulation. Ethanol (30%) extract of the dried leaf, in cell culture at a concentration of 25.0 mg/kg, did not elicit electrical activity and decreased glucose-stimulated spike activity on pancreatic beta cells. A dose of 200.0 mg/kg, administered intragastrically to mice, increased spike activity on exposure to glucose, an indicator of insulin release[GB0180].

Learning enhancement. Acetone/water (1:1) extract of the dried leaf, in the ration of male rats at a dose of 50.0 mg/kg, decreased the number of sessions to reach criterion performance, as well as the number of errors vs 8-armed radical maze[GB0149]. The 95% ethanol extract, administered intragastrically to mice at a dose of 100.0 mg/kg, improved the acquisition of a 2-response sequence and the retrieval of this response at a later date[GB0280].

Lipid peroxide formation inhibition. Ethanol (30%) extract of the dried leaf, in cell culture at a concentration of 400.0 mcg/ml, was active on pulmonary artery endothelial cells vs tert-butylperoxide-induced peroxidation[GB0131]. A dose of 100.0 mg/kg daily was administered intragastrically to rats for 10 days. The perfused retina was then isolated and subjected to Fe^{2+}/Na ascorbate-induced lipid peroxidation. The extract prevented a decrease in the electroretinogram B wave amplitude [GB0306]. The leaf, in cell culture at a concentration of 50.0 mcg/ml, was effective. Cyclosporin A-induced lipid peroxidation, as assayed by malondialdehyde formation, was entirely inhibited by this dose. The addition of ferric chloride to the incubation medium diminished the effect[GB0284].

Memory enhancement effect. Ethanol (30%) extract of the dried leaf, administered intragastrically to mice at a dose of 100.0 mg/kg, reduced the time to acquisition and enhancement performance in an operant conditioning task, but did not affect the performance in a passive avoidance test[GB0139]. A dose of 320.0 mg/person was taken orally by 18 elderly patients with age-related memory impairment. In the double-blind, crossover study of the effect on dual-coding abilities, the extract decreased the break point and dual coding from 960 and 1920 msec to 480 and 960 msec[GB0171]. A dose of 600.0 mg/person, taken orally by adults of both sexes, was equivocal. The double-blind, crossover study evaluated the effects of the extract on cognitive functions in healthy humans. The results showed a reduction in reaction time

on the Sternberg memory scanning test [GB0139]. Ethanol (95%) extract of the dried leaf was taken orally by 8 female volunteers at acute and ascending doses of 600.0, 140.0 and 120.0 mg with placebo. One hour after the treatment, the patients were subjected to a battery of tests including critical clicker fusion, choice reaction time, subjective rating scale and Sternberg memory scanning test. In the first 3 tests, no statistically significant differences with the placebo were observed. However, short-term memory, assessed by the Sternberg test, was significantly improved following the 600.0 mg dose, compared to the placebo. These results differentiate the extract from sedative and stimulant drugs, and indicated a specific effect on the memory processes[GB0255]. The leaf, taken orally by adults at a dose of 40.0 mg/person, was effective. Thirty-one patients with mild to moderate impairment in memory due to organic causes of at least 3 months duration, participated in a double-blind, placebo-controlled study. The dose was taken 3 times daily for 24 weeks. There was a significant improvement in the digit copying sub-test of the Kendrick battery, and in the median speed of response in a classification task[GB0283].

Memory retention impairment. Acetone/water (1:1) extract of the dried leaf, administered intragastrically to rats at a dose of 1.0 mg/kg, was not effective vs inhibitory avoidance conditioning and water maze performance[GB0152].

Memory retention improvement. Ethanol (30%) extract of the dried leaf, taken orally by 12 healthy females in a dummy placebo-controlled double-blind study at a dose of 600.0 mg/person, was not effective. The effect on psychomotor and amnesic performances of the acute oral dosing was evaluated. The objective measures of vigilance, choice reaction time, memory tasks and self-rating evaluation tests were performed. The testing sessions took place before and 1 hour after the treatment. No statistically significant changes from placebo were observed on objective measures of vigilance, choice reaction time or subjective rating of drug effects. No differences were seen between treatment on the Sternberg scanning test and picture recognition[GB0294]. The ethanol (95%) extract was effective when administered intragastrically to mice at a dose of 100.0 mg/kg for 4–8 weeks before operant conditioning and training, and for 10 weeks further[GB0280]. The hydro-alcoholic extract, administered intraperitoneally to female mice at a dose of 40.0 mg/kg, enhanced learning and memory in human adults and aged animals as demonstrated in performance tasks[GB0150].

Metabolites. Ethanol (30%) extract of the dried leaf, administered intragastrically to mice, produced the following metabolites in the plasma: 3,4-dihydroxyphenylacetic acid, hippuric acid, 3-hydroxyphenylacetic acid, homovanallic acid and benzoic acid[GB0216].

Microsomal metabolizing system induction. The leaf, taken orally by adults at a dose of 400.0 mg/day for 13 days, did not affect the elimination half-life of antipyrene[GB0334].

Moulting activity. Ethanol (95%) extract of the leaf was inactive on *Calliphora erythrocephala*[GB0337].

Muscarinic receptor increase. Ethanol (30%) extract of the dried leaf was active on the rat hippocampus[GB0301]. The dried leaf, administered orally to rats at a dose of 100.0 mg/kg daily for 28 days, was active. Receptor population of the 2-year old treated animals was similar to control animals aged 3 months, whereas 2-year old controls showed a significant decrease in receptors[GB0270].

Neural plasticity enhancement effect. Ethanol (30%) extract of the dried leaf, administered intraperitoneally to unilaterally

vestibular-neurectomized cats at a dose of 50.0 mg/kg daily for 30 days, was effective. The treatment accelerated postural compensation, locomotor balance recovery, spontaneous and evoked neck muscle activity, recovery of spontaneous firing rate of deafferented vestibular nucleus and synaptic reoccupation of the same nucleus in treated animals vs controls[GB0287].

Neuroexcitatory activity. Ethanol (30%) extract of the dried leaf, administered intracerebrally to guinea pigs at a dose of 10.0 mg/ml, was effective. The extract was directly infused into the area of the vestibular nuclei. A stereotyped reversible postural syndrome developed, which was mirror image-related to that induced by unilateral lesion of otolithic receptors, indicating excitation of the lateral vestibular nuclei[GB0159].

Neuroprotective effect. Ethanol (30%) extract of the dried leaf, administered intragastrically to rats of both sexes at a dose of 100.0 mg/kg, was effective vs neurochemical effects of electroconvulsive shock treatment. The extract reduced free fatty acid levels in the hippocampus and delayed the increase in diacylglycerol concentration in the hippocampus and cerebral cortex. Intraperitoneal administration reduced behavioral deficits resulting from bilateral frontal cortex lesions[GB0139].

Nitric acid synthase inhibition. Ethanol (30%) extract of the dried leaf, in cell culture, was active on macrophage cell line RAW 264.7 vs lipopolysaccharide plus interferon-gamma-induced nitric acid production, IC_{50} 100.0 mcg/ml[GB0135]. The extract also reduced the rate of production of nitrite from nitroprusside, IC_{50} 20.0 mcg/ml; and scavenges nitric oxide as shown by competition with the oxidation of oxyhemoglobin, IC_{50} 7.5 mcg/ml[GB0184].

Oxidative burst inhibition. Ethanol (30%) extract of the dried leaf, in cell culture at a concentration of 50.0 mcg/ml, was active on pulmonary artery endothelial cells[GB0223].

Peroxide formation inhibition. Ethanol (30%) extract of the dried leaf, at a concentration of 0.1 mcg/ml, was active on cerebellar neurons. Exposure of cultured neurons to the extract for 60 minutes resulted in a decreased intracellular H_2O_2 when determined by 21,7-dichlorofluroescin fluorescence[GB0168].

Pharmacokinetics. In a pilot study, two healthy volunteers took 50, 100 and 300 mg of the ethanol (30%) extract of the leaf in the form of coated tablets. Plasma concentrations of the flavonoids were measured over a period of 24 hours. The peak plasma concentrations were reached within 2-3 hours after intake and were proportional to the applied dose. The elimination phase was characterized by a typical exponential function. Twenty-four hours after intake the zero value was reached again[GB0300]. Ethanol (95%) extract of the dried leaf, administered by gastric intubation to rats, had a half-life of about 4.5 hours. The pharmacokinetics of the extract, based on blood specific activity data vs time course, were characteristic of a 2-compartment model with apparent first order phase. During the first 3 hours, radioactivity was primarily associated with the plasma. Specific activity peaked after 1 and 1.5 hours. Glandular and neuronal tissues and eyes showed a high affinity for the labeled extract[GB0253].

Phospholipase A2 activation. Acetone/water (70:30) extract of the dried leaf, in cell culture at a concentration of 0.3 mg/ml, was active on endothelial cells[GB0153].

Platelet aggregation inhibition. Ethanol (30%) extract of the dried leaf, taken orally by adults at a dose of 120.0 mg/person, was inactive vs ADP-induced aggregation, and a dose of 80.0 mg/person was active vs platelet aggregating factor-induced aggregation[GB0133]. A dose of 320.0 mg/person, taken orally by 10 volunteers with hemorheological abnormality, was active after 1 hour of administration. The extract taken was a

combination of *Ginkgo biloba* and *Panax ginseng* (3:5)[GB0165].

Platelet aggregation stimulation. Ethanol (95%) extract of the dried latex, taken orally by adults at a dose of 45.0 ml/person, was not effective[GB0275].

Prolactin inhibition. Ethanol (95%) extract of the dried leaf, in cell culture, was active on the rat pituitary, MIC 1.8 mcg/ml[GB0235].

Protein degradation inhibition. Ethanol (30%) extract of the dried leaf, at a concentration of 500.0 mcg/ml, inhibited protein polymerization on rat liver microsomes[GB0160].

Protein synthesis stimulation. Ethanol (30%) extract of the dried leaf, administered intragastrically to male rats at a dose of 100.0 mg/kg, was active vs ACTH-stimulated corticosterone production in adrenocortical cells[GB0145].

Radical scavenging effect. Ethanol (30%) extract of the dried leaf, at a concentration of 100.0 mcg/ml, was active vs peroxyl-induced lipid peroxidation[GB0200]. The leaf, at a concentration of 100.0 mcg/ml tested in a phenazine methosulfate and NADH system, was effective. A concentration of 125.0 mcg/ml was also effective when determined by low-temperature electron spin resonance[GB0268].

Receptor binding stimulant. Extract of the dried leaf, administered intraperitoneally to rats at a dose of 5.0 mg/kg daily for 21 days, had no effect on the density of tritiated-rauwolscine, which selectively binds alpha-2 adrenergic receptors on the hippocampus of young rats (4 months of age), but produced an increase in older animals (24 months of age)[GB0298].

Serotonin receptor regulation. Ethanol (30%) extract of the dried leaf, administered intraperitoneally to rats at a dose of 5.0 mg/kg daily for 21 days, increased binding density of labeled 8-hydroxy-2-(di-n-propylamino)tetralin to 5-HT-1A receptors on the cerebral cortex of aged animals[GB0181].

Serotonin uptake inhibition. Ethanol (30%) extract of the dried leaf, at concentrations of 32 mcg/ml to 2 mg/ml, was effective on mouse synaptosomes[GB0167].

Serotonin uptake stimulation. Ethanol (30%) extract of the dried leaf, at concentrations of 4–16 mcg/ml, was active on mouse synaptosomes. A concentration of 100.0 mg/kg, administered intragastrically to mice twice daily for 4 days preceding the assay, was active on synaptosomes[GB0167].

Smooth muscle relaxant activity. The nonginkolide-nonflavonoid subfraction of the dried leaf was effective on the corpus cavernosum vs norepinephrine-induced contractions, results significant at $p < 0.05\%$ level, ED_{50} 0.74 mg/ml[GB0234].

Spasmolytic activity. Flower buds, at concentrations of 30–300 mcg/ml, were active on the endothelial lining of a rabbit aorta vs phenylephrine-induced contractions[GB0278].

Thiobarbiturate reacting substance inhibition. Ethanol (30%) extract of the dried leaf was taken orally by 15 patients undergoing aortic valve replacement at a dose of 320 mg daily for 5 days prior to surgery. Upon aortic unclamping, the extract inhibited transcardiac release of thiobarbituric acid-reactive species, attenuated free radical levels and reduced delayed leakage of myoglobin and ventricular myosin leakage[GB0128].

Tumor promoting inhibition. Methanol extract of the fresh fruit, in cell culture at a concentration of 200.0 mcg/ml, was active on Epstein-Barr virus vs 12-0-hexadecanoylphorbol-13-acetate-induced Epstein-Barr virus activation[GB0333].

Vasoconstrictor activity. The dried entire plant was active on the rabbit vein. The effect was blocked by phenoxybenzamine, ED_{50} 86.0 mcg/ml[GB0325].

Vasodilator activity. Ethanol (30%) extract of the leaf, taken orally by adults at a dose of 17.5 mg/person, was effective on a group of 42 patients, normal or with

peripheral vascular diseases. The effect of the dose appears similar to that of ergot derivatives, acetylcholine and sodium nicotinate, but is significantly more constant [GB0274]. Water extract of the leaf, administered by intravenous infusion to a pregnant ewes at a concentration of 1-3.0 mg/kg, increased the fetal arterial pH and P-O_2, and decreased the base deficit and P-CO_2 in 45% of the cases. There was also an increase of uterine arterial blood flow. A dose of 140.0 mg/person, given to pregnant women during labor or 12 days before the onset of labor for the treatment of fetal asphyxia caused by impairment of utero-placental circulation unrelated to uterine hyperactivity, was effective[GB0106]. The dried leaf was taken orally by 79 patients with peripheral arterial insufficiency, at a dose of 40.0 mg/day for 60 months in a double-blind randomized clinical trial. The patients had obliterative arterial disease of the lower limbs, Fontaine's stage IIB. Pain-free walking distance, maximum walking distance and plethysmography recordings were used to assess the efficacy of the treatment. The results indicated that the treatment was active and significantly better than the placebo[GB0326].

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11 Glycyrrhiza glabra

Common Names

Arq sus	Morocco	Mulethi	India
Asloosoos	India	Muleti	India
Bouesc-dous	France	Mulhati	India
Buyan	Turkey	Mulhatti	India
Cha-em-thet	Thailand	Pega-dousa	France
Gancao	China	Persian licorice	Iran
Glycyrrhiza	USA	Recalisse	France
Glycyrrhizae radix	China	Reglisse	France
Jakyakgamcho-tang	South Korea	Russian licorice	USSR
Jashtimadhu	India	Si-pei	China
Jethimadha	India	Spanish licorice	Spain
Kanpo	Japan	Sussholzwurzel	Spain
Kanzo	Japan	Sweet wood	USA
Licorice root	USA	Walmee	India
Licorice	Israel	Welmii	India
Liquorice	India	Xi-bei	China
Madhuyasthi rasayama	India	Yashti	India
Morethi	India	Yashtimadhu	India
Mulathi	India		

BOTANICAL DESCRIPTION

A perennial of the LEGUMINOSAE family. It grows to a height of 1–2 m. It has dark green spreading pinnate leaves that are divided into pairs of narrow leaflets. The pea-like, purple-blue flowers arise from the leaf axils in a spike-like cluster. The pods are small and flat, 2–3 cm in length, turning brown at maturity and containing 1–7 small dark reniform seeds about the size of a pinhead. The plant has a deep tap root system, and produces horizontal stolons and rhizomes that spread out from the main plant just under the soil surface. The plant produces new shoots from buds on the underground stolons.

ORIGIN AND DISTRIBUTION

This native of the Mediterranean and Near East is distributed in the sub-tropical and warm temperature regions of the world.

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

TRADITIONAL MEDICINAL USES

China. Hot water extract of the dried root, mixed with *Triticum aestivum* and *Ziziphus jujuba*, is taken orally for emotional instability, infantile convulsions, and insomnia; with *Lonicera japonica* and *Stellaria dichotoma* as a detoxicant and for pyrexia; with *Panax ginseng* and *Glycyrrhiza glabra*, 6 gm each; *Athractylodes macrocephala*, *Angelica sinensis*, *Polygala tenuifolia*, *Euphoria longan*, and *Paeonia moutan*, 10 gm each; *Zizyphus spinosusi*, and *Gardenia jasminoides*, 12 gm each; *Astragalus* species and *Bletilla* species, 15 gm each; and *Agrimonia* species 30 gm. To restore vital function, a mixture with *Panax ginseng*, *Citrus reticulata*, *Equus asinus* hide and *Citrus aurantium*, 6 gm each; *Astragalus* species, *Angelica sinensis*, *Atractylodes macrocephala*, *Paeonia* species, *Rehmannia glutinosa*, and *Bletilla striata*, 10 gm each; and *Sanguisorba officinalis* 15 gm, is taken[T09788].

England. Hot water extract of the dried root is taken orally for gastric ulcers, and for amenorrhea[T09858].

France. Decoction of the dried root is taken orally as a diuretic, depurative, and emollient[K27340].

India. A mixture of 10 grams each of *Sida spinosa* root, *Glycyrrhiza glabra* root, *Lycium barbarum* (leaf), *Pistacia integerrima* galls, and *Mesua ferrea* anthers is mixed with honey, cow's milk, and ghee (milk fat), then taken orally in doses of 10 gm daily to produce sterility in the Bhat community[T01925]. The root, mixed with *Adhatoda zeylanica* and *Azadirachta indica*, is taken orally for bronchial troubles[K26376]. Hot water extract of the dried root is taken orally for irritated urinary organs, gastric ulcers, addison's disease, coughs and in throat lozenges, catarrhal disorders, as a tea to increase sexual vigor, as an anabolic and to improve the voice, for dermatological affections in Ayurvedic medicine, as an emmenagogue and in a mixture with *Terminalia arjuna*, *Sida retusa*, *Sida spinosa*, and ghee, for heart disease[T09366]. The hot water extract of the dried root is taken orally for tuberculosis[T09394]. Hot water extract of the rhizome and root is taken orally to improve sexual functions in the male. Traditionally it is recommended for males, but females have been using it also for the same effect[M18213]. Hot water extract of the root is taken orally as a galactagogue, emmenagogue, and aphrodisiac[A00449].

Israel. Hot water extract of the dried root, sweetened with sugar, is taken orally for lung ailments; the decoction is taken orally for kidney stones and ulcers[M22672]. The fresh leaf is used topically on wounds[M22672].

Morocco. Water extract of the root is taken orally as a cholagogue[K27820].

South Korea. Hot water extract of the dried root, in a mixture with *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus aurantium*, *Cimicifuga* species, and *Bupleurum* species, is taken orally to control digestive functions[T09705]. Hot water extract of the root, in a mixture of *Bupleurum falcatum*, *Scutellaria baicalensis*, *Panax ginseng*, *Glycyrrhiza glabra*, *Zingiber officinale*, *Ziziphus jujuba*, and *Pinellia tuberosa* is taken orally for tonsilitis, otitis media, tuberculosis, the common cold, liver disorders and chills and fevers[T11122]. Hot water extract of the rhizome is taken orally as a contraceptive[W00346].

Thailand. Hot water extract of the dried root is taken orally as an expectorant[W03804].

Turkey. Decoction of the root is taken orally for stomachache[K27061].

USA. Hot water extract of the dried root is taken orally as a cathartic[W03671], laxative, cough suppressant[L00715], and for cancer[T03436]. A teaspoonful of the dried root is taken once or twice daily in a cup of boiling water as a laxative, demulcent, and expectorant[W03968]. Infusion of the dried rhizome and root is taken orally to treat cystitis [J14032]; the fluid extract is taken for dysmenorrhea[T07821].

CHEMICAL CONSTITUENTS
(ppm unless otherwise indicated)

Abssinone II: Rt 69.9[H21113]
Acetoin: Rt EO[L02697]
Acetol: Rt EO[L02697]
Acetophenone,2,4-dihydroxy: Rt EO[L02697]
Amyrin,beta: Rt[A00012]
Anisole,4-propenyl: Rt[L02697]
Apigenin: Rt[K03299]
Astragalin: Lf, St[M20849]
Benzaldehyde: Rt EO[L02697]
Benzofuran,2,3-dihydro: Rt EO[L02697]
Benzoic acid: Rt[A04678]
Benzyl alcohol: Rt[L02697,N02085]
Bergapten, Lf: St[M20849]
Betulinic acid: Pl[K21540]
Bravachalcone, iso: Rt 60.1[H21113]
Butan-1-ol-2-one: Rt EO[L02697]
Butan-1-ol-3-one: Rt EO[L02697]
Butane-2,3-diol: Rt EO[L02697]
Butyric anhydride: Rt EO[L02697]
Butyrolactone,gamma: Rt EO[L02697]
Caproic acid: Rt EO[L02697]
Carvacrol: Rt EO[L02697]
Chalcone,3,3'-di-gamma-gamma-dimethyl-allyl,2,4,4-trihydroxy: Rt 140[H18792]
Chalcone,4-hydroxy: Rt[J01883]
Cresol: Rt[L02697]
Cyclopent-2-en-1-one,2-hydroxy-5-methyl: Rt EO[L02697]
Cymene, para: Rt[L02697]
Cymenol, para: Rt[L02697]
DNA: Rt[K28444]
Echinatin: Rt 300[H19475]
Estriol: Rt[A04678]
Euchrenone A-5: Rt 95.4[H21113]
Fenchone: Rt[L02697]
Flavone,5-7-dihydroxy-6-(gamma-gamma-dimethyl-allyl): Aer[M13969]
Flavone,iso, 7-acetoxy-2-methyl: Rt 17[K03299]
Flavone,iso, 7-hydroxy-2-methyl: Rt 4[K03299]
Flavone,iso, 7-methoxy-2-methyl: Rt 25[K03299]
Fluoride: Rt 4.2[T15629]
Formononetin: Rt 0.192%[K09820]
Fructose: Rt[M07997]
Furan,2-acetyl-5-methyl: Rt EO[L02697]
Furan,2-acetyl: Rt EO[L02697]
Furan-2-one,3-hydro-5-methyl: Rt EO[L02697]
Furan-3-one,2-tetrahydro-2-methyl: Rt EO[L02697]
Furan-3-one,tetrahydro, 2-methyl: Rt[L02697]
Furfural: Rt EO[L02697]
Furfural,5-methyl: Rt EO[L02697]
Furfuryl acetate: Rt EO[L02697]
Furfuryl alcohol: Rt EO[L02697]
Furfuryl butyrate: Rt EO[L02697]
Furfuryl formate: Rt EO[L02697]
Furfuryl propionate: Rt EO[L02697]
Furfuryl,2,4-di, furan: Rt EO[L02697]
Furfuryl,di, ether: Rt EO[L02697]
Furyl ethyl ketone: Rt EO[L02697]
Furyl methyl ketone: Rt[L02697]
Furyl,2-2,di, ethane: Rt EO[L02697]
Furyl,2-2-di, ethylene: Rt EO[L02697]
Furyl,2-2-di, methane: Rt EO[L02697]
Galangin: Aer[J11413,M13969]
Genistein: Lf 940[K27056], Aer[M13969]
Genistein,3'-6-(dimethyl-allyl): Rt 5[H18364]
Geraniol: Rh EO[N02085]
Glabranin: Aer 0.31%[M13969], Rt[T01382]
Glabranin A: Rt[N19034]
Glabranin B: Rt[N19034]
Glabrene: Rt 800[M28111]
Glabric acid: Rt[A05989]
Glabridin: Rt 0.15-0.7%[K24219]
Glabridin,3'-hydroxy-4'-0-methoxy: Rt 100[H17895]
Galbridin,3'-methoxy: Rh 116[M16692]
Glabridin,4'-0-methyl: Rt 88-169[H17895,M16692]
Glabrocoumarone A: Rt 0.147%[H18792]
Glabrocoumarone B: Rt 66[H18792]
Glabrol: Rt 0.13%[H19475]
Glabrol,3-hydroxy: Rh 23[M16692], Rt 266[H18792]
Glabrolide: Rt[A05989]
Glabrolide,11-deoxo: Rt[A05989]
Glabrolide,iso: Rt[A05989]
Glabrolide,iso, 21-alpha-hydroxy: Rt[A05989]
Glabrone: Rt 12[K04125]
Glucose: Rt 3.19-4.23%[L00299]
Glycerrhetic acid,28-hydroxy: Rt[J04392]
Glycestrone: Aer[A00013]
Glycycoumarin: Rh, Rt[M24467]
Glycycoumarin,iso: Rh, Rt[M30792]
Glycyrin: Rt[M06494]
Glycyrol: Rt[M06494]
Glycyrol,iso: Rt, Rh[M24467]
Glycyrram: Rt[M14578]
Glycyrrhetinic acid: Rt 1.9-2.2%[N01578]
Glycyrrhetinic acid monoglucuronide: Rt[M29302]

Glycyrrhetinic acid, beta: Rt 4.39%[K09820]
Glycyrrhetinic acid,18-alpha: Rt 0.13-0.71%[M07972]
Glycyrrhetinic acid,18-beta: Rt 7.0-16.8%[M07972]
Glycyrrhetinic acid,beta: Rt 0.88%[N01888]
Glycyhrrhetol: Rt[A05989]
Glycyrrhiza galactomannan: Sd 5.0%[H09651]
Glycyrrhiza glabra triterpene mp 288-290: Rt 80[J07913]
Glycyrrhizin: Rt 0.12-2.24%[K26760]
Glycyrrhizin: Rt 1-52.06%[K15379]
Glycyrrhizin,apio: Rt 200[H19475]
Glycyrrhizin,arabo: Rt 0.02%[H19475]
Glycyrrhizinic acid,18-alpha: Rt[N14584]
Glycyrrhizinic acid, 18-beta: Rt[N14584]
Glyinflanin G: Rt 0.01%[H19154]
Glyzaglabrin: Rt[M00142]
Glyzarin: Rt[N00756]
Guaiacol: Rt[L02697]
Hederasaponin C: Rt[M09959]
Heptalactone,gamma: Rt EO[L02697]
Heptane-1-2-diol: Rt EO[L02697]
Hex-trans-3-en-l-ol: Rh EO[N02085]
Hexalactone, gamma: Rt[L02697]
Hexan-l-ol: Rt[L02697]
Hispaglabridin B: Rh 118[M16692], Rt 81[H17895]
Hispaglabridin B, methyl: Rt 6[H19475]
Hispaglabridin A: Rt 60-127[M16692]
Indole: Rt[L02697]
Kaempferol: Rt[K03299], Lf, St[M20849]
Kanzonol B: Rt 23.8[H21113]
Kanzonol R: Rt 10[H13735]
Kanzonol T: Rt 5[H18364]
Kanzonol U: Rt 3.75[H19154]
Kanzonol V: Rt 11.1[H19154]
Kanzonol W: Rt 11.1[H19154]
Kanzonol X: Rt 48.1[H19154]
Kanzonol Y: Rt 22.2[H19154]
Ketone,methyl-ethyl: Rt EO[L02697]
Kumatakenin: Rt[M06494]
Lavandulol: Rt[L02697]
Leiocarpin,hemi, ent(-): Rt 10[H19475]
Licoagrocarpin: Rt 7.8[H21113]
Licoagrochalcone A: Rt 6.0[H21113]
Licochalcone A: Rt 55[H18364]
Licochalcone B: Rt 100[H19475]
Licocoumarone: Rt[M31271]
Licoflavanone: Lf 800[K27056], Rt 700-7900[K24219]
Licoflavone A, prenyl: Rt 1000[H19475]
Licoflavone A: Rt 1000[H19475]
Licoflavone B: Rt[M06494]
Licoflavonol: Rt[M06494]
Licoisoflavanone: Rt 5[H18364]
Licoisoflavone B: Rt 57.5[H18364]
Licoisoflavone C: Rt[M06494]
Licoisoflavone A: Rt[M06494]
Licorice saponin A-3: Rt 400[H19475]
Licorice saponin C-2: Rt 60[H19475]
Licorice saponin E-2: Rt 800[H19475]
Licorice saponin G-2: Rt 900[H19475]
Licorice saponin H-2: Rt 2300[H19475]
Licuraside: Rt 2000[H19475]
Licuroside,neo: Rh[M19116]
Licuroside: Rt[M19116]
Ligustrazine: Rh EO[N02085]
Likviritin: Rt[K11066]
Linalool A oxide: Rh EO[N02085]
Linalool B oxide: Rh EO[N02085]
Linalool oxide: Rt[L02697]
Linalool acid ethyl ester: Rt EO[L02697]
Linalool: Rt[L02697]
Linolenic acid ethyl ester: Rt EO[L02697]
Liqcoumarin: Rt 23[K01941]
Liquirazide: Rt[A05989]
Liquiritic acid,24-hydroxy: Rt[A05989]
Liquiritic acid: Rt[A05989]
Liquiritigenin iso: Rt 9610[K09820]
Liquiritigenin: Rt[K03299]
Liquiritin apoiside: Rt 9800[H19475]
Liquiritin,gluco, apioside: Rt 40[H19475]
Liquiritin, iso: Rt 920-1500[M26994,H19475]
Liquiritin,iso, apioside: Rt 1.65%[H19475]
Liquiritin,neo-iso: Rt 300[H19475]
Liquiritin,neo: Rt[M06494]
Liquiritin,neo, iso: Rt[A05989]
Liquiritin: Rt 2300[M28190]
Liquoric acid: Rt[A05989]
Lonchocarpin,4-hydroxy: Rt 27.6[H21113]
Lupeol: Pl[K21540]
Lupiwighteone: Lf 170[K27056]
Maltol: Rt EO[L02697]
Maltose: Rt[M07997]
Medicarpin: Rt 900[H19475]
Mucronulatol,iso: Lf[L02443]
Naringenin,6-prenyl: Lf 740[K27056]
Naringenin: Aer[M13969]
Nicotinic acid: Lf 100-1000[W03668]
Nonacosane,n: Rt[A00012]
Nonalactone,gamma: Rt[L02697]
Nonanoic acid: Rt[L02697]
Oct-l-en-3-ol: Rh/Rt EO[L02697,N02085]
Octacosan-l-ol: Rt[A00012]

Octadec-trans-10-enoic acid,9,1213-trihydroxy: Rt, St[M25110]
Octadecanoic acid,9,12,13-trihydroxy-10,11-epoxy: Rt, St[M25110]
Octalactone,gamma: Rt[L02697]
Octanoic acid: Rt EO[L02697]
Oleana-11,13(18)0dienoic acid-3,24-dihydroxy: Aer[K01990]
Oleana-9(11)-12-dienoic acid-3,24-dihydroxy: Aer[K01990]
Ononin: Rt 320-700[M26964,H19475]
Palmitic acid ethyl ester: Rt EO[L02697]
Pectin: Aer 5.8%[N00553]
Pentan-2-one,4-hydroxy-4-methyl: Rt EO[L02697]
Pentan-l-ol: Rh EO[N02085]
Phaseollin,1-methoxy: Rt 70[H19475]
Phaseollinisoflavan,8-prenyl: Rt 9[H17895]
Phaseollinisoflavan: Rt[N00846], Rh 26.7[M16692]
Phenethyl alcohol: Rh EO[N02085]
Phenol,ethyl: Rt[L02697]
Phenol,ortho,methoxy: Rt EO[L02697]
Phenol,para,methoxy: Rt EO[L02697]
Phenol: Rt EO[L02697]
Phenylacetate, ethyl: Rt EO[L02697]
Phenylethanol,2: Rt EO[L02697]
Phenylethyl alcohol,dimethyl: Rt[L02697]
Phenylethyl alcohol: Rt[L02697]
Phenylpropionic acid: Rt EO[L02697]
Phthalate,butyl: Rt EO[L02697]
Pinocembrin: Pl[J08389], Lf 0.8-1.55%[K24219]
Polysaccharide: Aer 0.8%[N00553]
Primula acid A: Rt[M09959]
Propan-2-one,1-(2-furyl): Rt EO[L02697]
Propane-1,2-dione,1-(5-methyl-2-furyl): Rt EO[L02697]
Propionic acid: Rt EO[L02697]
Prunetin: Lf 180[K27056]
Pyrazine,2-ethyl-6-methyl: Rt EO[L02697]
Pyrazine,trimethyl: Rt EO[L02697]
Pyrazine,2,6-dimethyl: Rt EO[L02697]
Pyrazole: Rt EO[L02697]
Pyrrole,1-furfuryl-2-formyl: Rt EO[L02697]
Pyrrole,1-methyl-2-formyl: Rt EO[L02697]
Pyrrole,2-acetyl: Rt[L02697]
Pyrrole,2-formyl-5-methyl: Rt EO[L02697]
Pyrrole,1-furfuryl-2-acetyl: Rt EO[L02697]
Quercetin, Rt 2-formyl-5-methyl: Rt EO[K03299]
Salicyclic acid,o-acetyl: Rh 1636[M16692]
Salicyclic acid: Rh 567.3[M16692]
Shinflavonone: Rt 913[H18792]
Shinpterocarpin: Rt 25.9[H19154]
Sitosterol,beta: Rt 500[A00010]
Soyasaponin I: Pl[M25235]
Soyasaponin II: Pl[M25235]
Soyasaponin: Rt 0.1-0.7%[K16587]
Squalene synthase: Pl[K28772]
Stigmasterol: Rt[A00012]
Sucrose,D: Rh[A06628]
Sucrose, Rt 5.28-9.17%[L00299]
Terpin-l-en-4-ol: Rh EO[N02085]
Terpineol,alpha: Rt[L02697]
Tetracosan-l-ol: Rt[A00012]
Tetradecan,n: Rt[L02697]
Thujone: Rt[L02697]
Thymol: Rt EO[L02697]
Tigaldehyde: Rt EO[L02697]
Toluene,4-propenyl: Rt[L02697]
Uralsaponin B: Rh-Rt 0813%[M30792], Rt[L02697]
Wighteone: Lf 420[K27056]
Xambioona: Rt 7.8[H21113]
Xanthotoxin: Lf, St[M20849]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

ACTH-induction. Water extract of the dried root, in a mixture containing *Bupleurum falcatum* (7 gm), *Pinella ternata* (5 gm), *Scutellaria baicalensis* (3 gm), *Zingiber officinale* (4 gm), *Ziziphus inermis* (3 gm), and *Glycyrrhiza glabra* (2 gm), administered intraperitoneally to rats at a dose of 200.0 mg/kg, produced an increase in plasma ACTH level relative to controls. The increase was not found in adrenalectomized animals or dexamethasone-treated animals[T14878].

Acyl-Co-A:cholesterol acyltransferase inhibition. Decoction of the dried rhizome, administered intragastrically to mice at a dose of 1.2 gm/kg, was active. The incorporation of oleic acid into cholesteryl oleate was inhibited. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K08369].

Alanine aminotransferase inhibition. Decoction of the dried rhizome, taken orally by 80 adults of both sexes with Hepatitis B antigen positive and treated for 6 months at a dose of 7.5 gm/day, was active. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit and *Panax ginseng* root[K13785].

Aldehyde reductase 1 inhibition. A dose of 7.5 ml/kg was active on the rat red blood cells[M28880].

Aldol reductase inhibition. Chromatographic fraction of the dried root was active, IC_{50} 0.72 micromols[M14042].

Aldosterone agonist activity. The dried rhizome, taken orally by 6 adults at a dose of 7.5 gm/person daily, decreased plasma renin activity and urinary aldosterone[K16152]. Water extract of the dried root, taken orally by adults at a dose of 3.0 gm/person daily, ameliorates postural hypotension due to diabetic peripheral neuropathy, probably through volume expansion[K19271].

Aldosterone decrease. Hot water extract of the dried root, taken orally by healthy adults at a dose of 100 gm daily for 8 weeks (0.7 gm glycyrrhizic acid), was effective. Aldosterone was measured in the urine and plasma[M21430]. Water extract of the rhizome, taken orally by adults at variable dosage levels, was effective[M31333].

Alkaline phosphatase stimulation. The dried root, together with *Glycine max* in the ration of rats at a dose of 0.38% of the diet, was active[K09254].

Analgesic activity. A preparation that included *Coptis chinensis*, *Scutellaria baicalensis*, *Lirope* species, *Pinellia ternata*, *Lycium* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, *Glycyrrhiza glabra* (1.875 gm each), and *Zingiber officinale* (3.75 gm) was effective vs acetic acid-induced writhing and pressure pain threshold test[M20428]. Decoction of the dried root, in a mixture of *Cinnamomum cassia* bark, *Zingiber officinale* rhizome, *Ziziphus jujuba* fruit, *Ephedra sinica* stem, *Asiasarum* species root, and *Aconitum* species root, administered intragastrically to mice at a dose of 1.2 gm/kg, was not effective when tested for analgesia by the hot plate method. A dose of 300.0 mg/kg was effective vs cold stress-induced hyperalgesia; a dose of 100.0 mg/kg was effective vs adjuvant-induced hyperalgesia[M24676]. Hot water extract of the dried root, in a mixture with *Paeonia albiflora*, administered by gastric intubation to mice at a dose of 18.0 mg/kg, was effective vs acetic acid-induced writhing, results significant at $p < 0.001$ level. The hot water extract, at a dose of 18.0 mg/kg, produced a weak effect vs acetic acid-induced writhing[T11694]. Hot water extract of the dried root, in a mixture with *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus aurantium*, *Cimicifuga* species, and *Bupleurum* species, administered by gastric intubation to mice at a dose of 0.25 mg/gm, was effective vs acetic acid-induced writhing, results significant at $p < 0.01$ level. A dose of 1.0 gm/kg, administered to rats by gastric intubation, was effective vs pressure pain threshold test[T09702]. Methanol extract of the dried root, administered by gastric intubation to mice at a dose of 1.0 gm/kg, was active vs inhibition of acetic acid-induced writhing, results significant at $p < 0.001$ level[T12842].

Anesthetic activity. Hot water extract of the root, at a concentration of 2.0%, was effective on the sciatic nerve[T01091]. Decoction of the dried root, in combination with *Triticum aestivum* and *Ziziphus jujuba*, at a concentration of 5.0% was effective vs nerve action potential[M18551]. Ethanol (30%) extract of the root, applied ophthalmically to rabbits at a concentration of 10.0%, was not effective[T01446].

Angiogenesis inhibition. Water extract of the dried root, in cell culture, was effective on vascular endothelium. Tube formation was assayed, IC_{50} 0.518 mg/ml[K23386]. A dose of 80.0 mg/kg, administered intraperitoneally to mice, was effective when assayed in Freund's adjuvant-induced granuloma[K23386].

Antiallergenic activity. Decoction of the dried root, in cell culture at a concentration of 250.0 mcg/ml, was effective on monocytes vs interleukin 4-induced CD23 expression as a model of atopy[K20398]. Hot water and methanol extracts of the dried root, administered by gastric intubation to mice at a dose of 100.0 mg/kg, were not effective vs Type IV reaction with contact dermatitis induced by picryl chloride. Dosing was immediately before and 16 hours after challenge. The hot water and methanol extracts, administered by gastric intubation to rats at a dose of 200.0 mg/kg, were not effective vs Type I reaction induced by anti-dinitrophenylated ascaris IgE serum in 48-hour homologous PCA in rats. Dosing was 1 hour before challenge[T06654]. Hot water extract of the dried root, in a mixture containing *Pinella ternata* tuber, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Pachyma hoelen*, *Scutellaria baicalensis* root, *Panax ginseng* root, *Ziziphus vulgaris* fruit, *Magnolia officinalis* bark, and *Perilla frutescens* herb in the following proportions: 9:4:3:2:1.5:1.5:1.5:1.5:1.5:1, administered by gastric intubation to mice at a dose of 100.0 mg/kg, was effective vs Type IV reaction with contact dermatitis induced by picryl chloride. Dosing was immediately before and 16 hours after challenge, results significant at $p < 0.05$ level. Methanol extract of the dried root, administered by gastric intubation to rats at a dose of 100.0 mg/kg 2 hours before challenge, was effective vs Type I reaction induced by anti-dinitrophenylated ascaris-IgE serum in 48-hour homologous PCA, results significant at $p < 0.05$ level[T06654].

Antiasthmatic activity. The dried root, in a mixture that contained *Curcuma longa* taken orally by 26 patients (11 male and 15 female) with bronchial asthma at a dose of 250.0 mg/person once daily for 3 weeks, was effective[T03554].

Antibacterial activity. Ethanol (80%) extract of the dried root, on agar plate at a concentration of 1.0 mg/ml, was active on *Staphylococcus aureus*[T07382]. Ethanol (94%) extract of the root, on agar plate, was active on *Staphylococcus aureus*[N00846]. Ethanol (95%) and water extracts of the dried rhizome, on agar plate at a concentration of 10.0 mg/ml, were inactive on *Corynebacterium diptheriae*, *Diplococcus pneumoniae*, and *Streptococcus viridans*, and produced weak activity on *Staphylococcus aureus* and *Streptococcus pyogenes*[M29966]. Juice of the dried root, on agar plate at a concentration of 5.0%, was active on *Streptococcus mutans*. Ethanol (95%) extract of the stem, on agar plate, was active on *Bacillus subtilis*, *Vibrio cholera*, and *Staphylococcus aureus*[W00232]. Methanol extract of the aerial part, on agar plate at a concentration of 1.0 ml/plate, was active on *Bacillus subtilis*, *Sarcina subflava*, *Staphylococcus aureus*, and *Streptococcus sobrinus*, and inactive on *Citrobacter diversus*, *Citrobacter freundi*, *Enterobacter aerogenes*, *Escherichia coli*, *Proteus mirabilis*, *Proteus morganii*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella paratyphi*, *Salmonella typhi*, *Serratia marcescens*, *Shigella boydi*, and *Shigella flexneri*[T15721]. Saponin fraction of the dried root, on agar plate, was equivocal on *Escherichia coli*, *Pseudomonas acrugenea*, *Staphylococcus aureus*, and *Streptococcus faecalis*, MIC 0.63%[K27726]. Water extract of the dried root was found to have a coliform count of 0.0001 in the fresh crude drug, and a count of 0.01 was found in sample stored for 1 year at 15–20 degrees Celsius[T09452].

Antibody formation enhancement. Decoction of the dried rhizome, in cell culture, was active on peripheral blood monocytes

from healthy adults who were treated with pokeweed mitogen. The treatment enhanced plaque cell formation in response to the sheep red blood cells. The study was conducted with a Kampoh, a prescription known as Shosaikoto, which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Arachidonic acid release inhibition. Decoction of the dried rhizome, in cell culture, was active on macrophages. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Antibody formation enhancement. Decoction of the dried root, in cell culture at a concentration of 100.0 mcg/ml, was effective. Peripheral lymphocytes from 8 patients with chronic active hepatitis, 4 with HBEAG and 4 with HBE, were cultured with the decoction. Anti-HBC and anti-HBE antibodies were produced by HBCAG stimulation[K07057].

Anticholinergic activity. A preparation that included *Coptis chinensis*, *Scutellaria baicalensis*, Liriope sp., *Pinellia ternata*, Lycium sp., Pachyma sp., *Paeonia rubra*, Akebia sp., *Rehmannia glutinosa*, *Glycyrrhiza glabra* (1.875 gm each), and *Zingiber officinale* (3.75 gm), was active on mouse ileum vs ACh-induced contractions[M20428].

Anticonvulsant activity. A preparation that included *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, *Glycyrrhiza glabra* (1.875 gm each), and *Zingiber officinale* (3.75 gm), administered to mice at a dose of 1.0 gm/kg, was active vs strychnine and picrotoxin-induced convulsions[M20428]. Decoction of the dried root, in a Japanese formula 'Shosaiko-to-keishi-ka-shoyakuyaku-to' (TJ-960), containing *Paeonia albiflora*, *Cinnamomum zeylanicum*, *Bupleurum falcatum*, *Zingiber officinale*, *Scutellaria baicalensis*, *Panax ginseng*, *Pinellia ternata*, and *Ziziphus jujuba*, administered intragastrically to mice and intravenously to male rats at a dose of 1.0 gm/kg, was active vs metrazole-induced convulsions[M31385]. Decoction of the dried root, in a mixture containing *Bupleurum falcatum* root, *Cinnamomum cassia* bark, *Paeonia albiflora* root, *Zingiber officinale* rhizome, *Panax ginseng* root, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, and *Ziziphus jujuba* fruit, taken orally by 24 patients with frequent uncontrollable epileptic seizures at a concentration of 1.5 gm/person, was active. The treatment resulted in 6 cases that were well controlled (no fit for 10 months), 13 were improved (marked decrease or grand mal was eliminated), and 3 cases that showed no effect. No patient had conditions that worsened[T08450]. Water extract of the root, in a mixture containing *Zingiber officinale*, *Panax ginseng*, *Scutellaria baicalensis*, *Ziziphus jujuba*, *Pinellia ternata*, *Bupleurum falcatum*, *Cinnamomum cassia*, and *Paeonia albiflora*, administered by gastric intubation to mice at a dose of 4.0 gm/kg, was active vs supramaximal electroshock-induced convulsions and audiogenic seizures, results significant at $p < 0.05$ level. The treatment was inactive vs strychnine- and pentenetetrazide-induced convulsions[T08515]. Hot water extract of the root, at a concentration of 1.07%, was inactive vs inhibition of metrazol-induced bursting of snail neurons[T00348].

Anticrustacean activity. Ethanol (95%) extract of the dried root was inactive on *Artemia salina*, LD_{50} 237 mcg/ml[K08041].

Antidiarrheal activity. Hot water extract of the dried root, in a mixture containing *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus auran-*

tium, *Cimicifuga* species, and *Bupleurum* species, administered by gastric intubation to mice at a dose of 0.5 gm/kg, was effective vs castor oil-induced diarrhea, results significant at p <0.05 level[T09705]. Water extract of the dried root, in a mixture with *Pinellia ternata*, *Citrus aurantium*, *Pachyma hoelen*, and *Zingiber officinale*, administered by gastric intubation to mice at a dose of 0.5 mg/gm, was effective vs castor oil-induced diarrhea[T11368].

Antidiuretic activity. Hot water extract of the dried root, taken by healthy adults at a dose of 100.0 gm daily for 8 weeks (0.7 gm glycyrrhizic acid), produce mild to severe edema in 9 of 15 subjects. The signs disappeared 2 weeks after the dosing ended[M21430].

Antidiuretic hormone decrease. Hot water extract of the dried root, taken by healthy adults at a dose of 100.0 gm daily for 8 weeks (0.7 gm glycyrrhizic acid), decreased the hormone level in plasma[M21430].

Antieczema effect. Decoction of the dried root, taken orally by a group of 40 adults with refractory atopic dermatitis at a dose of 200.0 ml/person daily for 8 weeks, was effective. The treatment consisted of the dried rhizome in a mixture of *Ledebouriella seseloides*, *Potentilla chinensis*, *Clematis armandil*, *Rehmannia glutinosa*, *Paeonia albiflora*, *Lophaterum gracile*, *Dictamnus dasycarpus*, *Tribulus terrestris*, and *Schizonepeta tenuifolia*[K09062]. Decoction of the dried root, in a Chinese traditional prescription containing *Ledebouriella seseloides*, *Clematis armandii*, *Rehmannia glutinosa*, *Paeonia albiflora*, *Lophatherum gracile*, *Dictamnus dasycarpus*, *Tribulus terrestris*, and *Schizonepeta tenuifolia*, was effective[J12590]. The same prescription, at a dose of 200.0 ml/day taken orally by 31 patients with severe ectopic eczema, was effective[K20199].

Antifatigue activity. Water extract of the dried root, in a mixture composed of *Paeonia* species, *Angelica giga*, *Astragalus membranaceus*, *Cnidium officinale*, *Rehmannia glutinosa*, Atractylodes species, *Pueraria* species, *Cinnamomum cassia*, *Zingiber officinale*, *Ziziphus vulgaris*, and *Panax ginseng*, administered intragastrically to mice at a dose of 1.5 gm/kg, was effective[M25858]. Ethanol (95%) extract of the dried root, taken orally by adults at a dose of 2.5 gm/person, was effective in cases of chronic fatigue syndrome[K20308].

Antifungal activity. Acetone, ethanol (95%), and water extracts of the dried root, on agar plate at a concentration of 50%, were inactive on *Neurospora crassa*[W04570]. Ethanol (95%) extract of the dried root, on agar plate, was equivocal on *Rhizoctonia solani*, inactive on *Alternaria kikuchiana*, *Solani phaseoli*, and *Phomopsis mali*, and produced weak activity on *Aphanomyces euteiches*[J12441]. Ethanol (95%) extract of the stem, on agar plate, was active on *Trichophyton mentagrophytes* and *Trichophyton rubrum*[W00232]. Ethanol/water (1:1) extract of the dried root, on agar plate at a concentration of 417.0 mg of plant material/ml, was inactive on *Aspergillus fumigatus*, *Aspergillus niger*, *Botrytis cinerea*, *Penicillum digitatum*, *Rhizopus nigricans*, and *Trichophyton mentagrophytes*[T16238]. The dried root, in broth culture at a dose of 10.0 gm/liter, was inactive on *Aspergillus flavus*. The production of aflatoxin was inhibited at lower doses[T08142]. The dried root, on agar plate, was active on *Aspergillus auricomus*, *Aspergillus candidus*, *Aspergillus fischeri*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus nidulans*, *Aspergillus niger*, *Aspergillus sydowi*, *Aspergillus terreus*, *Aspergillus terricola*, *Aspergillus ustus*, and *Aspergillus versicolor*[P00005].

Antigen expression inhibition. Decoction of the rhizome, in cell culture at a concentration of 100.0 mcg/ml, was active on lymphocytes taken from ARC, HIV-positive asymptomic, and AIDS patients. The study was conducted in Japan with a Kampoh prescription known as 'Shosaikoto', which consists of *Bupleurum falcatum* root, *Zingiber officinales* rhizome, *Scutellaria baicalensis*

root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[M27622].

Antihemorrhagic activity. Decoction of the dried root, in a mixture containing *Panax ginseng* and *Glycyrrhiza glabra*, 6 grams each; *Atractylodes macrocephala*, *Angelica sinensis*, *Polygala tenuifolia*, *Euphoria longana*, and *Paeonia moutan*, 10 grams each; *Ziziphus spinosus* and *Gardenia jasminoides*, 12 grams each; *Astragalus* species and *Bletilla* species, 15 grams each; and *Agrimonia* species, 30 grams. A 4 year-old girl with burns over 20% of her body surface was treated for massive gastrointestinal hemorrhage. The patient was given blood transfusion and the herb decoction by a nasogastric tube. After 5 days the gastric juice was normal on examination, and another 4 days a hematest negative stool was obtained. The patient's general condition was markedly improved with no signs of repetition of bleeding[T09788].

Antihemorrhoidal activity. Ethanol (95%) extract of the dried root, administered intraduodenally to rats at dose of 400.0 mg/kg, produced weak activity, results significant at $p < 0.05$ level[W03673].

Antihepatotoxic activity. Hot water extract of the dried root, in a mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinellia ternata*, 3 gm *Scutellaria baicalensis*, 2 gm *Glycyrrhiza glabra*, 1 gm *Zingiber officinale*, 3 gm *Panax ginseng*, and 3 gm *Ziziphus jujuba* in 700 ml water, administered intragastrically to mice for 1 month, was active vs CCl_4-induced hepatotoxicity[M20760]. Hot water extract of the dried root, in a mixture containing 5 gm *Bupleurum falcatum*, 4 gm *Pinella ternata*, 2 gm each *Scutellaria baicalensis*, *Zingiber officinale*, *Cinnamomum cassia*, *Ziziphus inermis*, *Glycyrrhiza glabra*, and *Paeonia albiflora* and 1.5 gm *Panax ginseng*, administered intraperitoneally to rats at a dose of 200.0 mg/kg, was active. A mixture of 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm of *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng* suppressed hyaline degeneration of the liver induced by D-galactosamine and hepatic glutamine synthetase activity vs d-galactosamine-induced hepatotoxicity[T14824]. Hot water extract of the root, in a mixture containing *Bupleurum falcatum*, *Zingiber officinale*, *Scutellaria baicalensis*, *Pinellia ternata*, *Ziziphus jujuba*, *Glycyrrhiza glabra*, and *Panax ginseng*, administered by gastric intubation to rats at a dose of 400.0 mg/kg, was active vs CCl_4-induced hepatotoxicity[T11122]. Methanol extract of the dried root, in a mixture containing *Machilus* species, *Alisma* species, *Amomum xanthiodes*, *Bulboschoenus maritimus*, *Artemisia iwayomogis*, *Atractylodes japonica*, *Crataegus cuneata*, *Hordeum vulgar*, *Citrus sinensis*, *Polyporus umbellatus*, *Agastache rugosa*, *Raphanus sativus*, *Poncirus trifoliatus*, *Curcuma zedoaria*, *Citrus aurantium*, *Saussurea lappa*, and *Zingiber officinale*, administered by gastric intubation to rabbits at a dose of 0.5 gm/kg, was active vs CCl_4-induced hepatotoxicity[T08441]. The powdered, dried root, in the ration of rats at a concentration of 5.0% of the diet, was active vs elevated liver enzymes induced by cholic acid and diet[K08429]. Water extract of the dried rhizome and root, taken orally by 13 chronic hepatitis patients over the age of 62 at a dose of 5.0 gm/day for 6 months, was active. Serum aminotransferase and alanine aminotransferase levels dropped. Alkaline phosphatase, cholinesterase, and zinc sulfate levels were unaffected[M22529].

Antihistamine activity. A preparation that included *Coptis chinensis*, *Scutellaria baicalensis*, Liriope species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, *Glycyrrhiza glabra* (1.875 gm each), and *Zingiber officinale* (3.75 gm), was active on mouse ileum vs histamine-induced contractions[M20428].

Antihypercholesterolemic activity. Methanol extract of the dried root, in a mixture

containing *Machilus* species, *Alisma* species, *Amomum xanthiodes*, *Bulboschoenus maritimus*, *Artemisia iwayomogis*, *Atractylodes japonica*, *Crataegus cuneata*, *Hordeum vulgar*, *Citrus sinensis*, *Polyporus umbellatus*, *Agastache rugosa*, *Raphanus sativus*, *Poncirus trifoliatus*, *Curcuma zedoaria*, *Citrus aurantium*, *Saussurea lappa*, and *Zingiber officinale*, administered by gastric intubation to rabbits at a dose of 0.5 gm/kg, was effective, results significant at p <0.01 level[T08441]. The powdered, dried root, in the ration of rats at a concentration of 5.0% of the diet, was effective. The effect was seen in animals made hypercholesterolemic with cholic acid and diet[K08429].

Antihyperglycemic activity. Hot water extract of the dried root, in the ration of mice at a dose of 6.25% of the diet, was not effective vs streptozotocin-induced hyperglycemia[M24255]. The powdered, dried root, in the ration of rats at a concentration of 5.0% of the diet, was effective. The effect was seen in animals made hyperglycemic with cholic acid and diet[K08429]. Water extract of the dried root, administered intragastrically to mice at a dose of 1.0 gm/kg 1 hour after streptozotocin and twice daily for 3 subsequent days, was effective. Blood glucose was 197.8 vs 236.3 mg/dl for controls vs streptozotocin-induced hyperglycemia[M28457].

Antihyperlipemic activity. The powdered, dried root, in the ration of rats at a concentration of 5.0% of the diet, was effective. The effect was seen in animals made hypercholesterolemic with cholic acid and diet[K08429].

Antihypertriglyceridemia effect. The powdered, dried root, in the ration of rats at a concentration of 5.0% of the diet, was effective. The effect was seen in animals made hypercholesterolemic with cholic acid and diet[K08429].

Anti-inflammatory activity. A preparation that included *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, *Glycyrrhiza glabra* (1.875 gm each), and *Zingiber officinale* (3.75 gm), at a dose of 2.0 gm/kg, was effective vs carrageenin and histamine-induced pedal edema[M20428]. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 2.0 gm/kg, was effective vs formalin-induced pedal edema[K26333]. Decoction of the dried root, in an oriental medicine containing *Cinnamomum cassia* bark, *Zingiber officinale* rhizome, *Ziziphus jujuba* fruit, *Ephedra sinica* stem, *Asiasarum* species root, and *Aconitum* species root, administered intragastrically to rats at a dose of 100.0 mg/kg, was not effective vs adjuvant-induced arthritis[M24676]. The ethanol (95%) extract, administered intraperitoneally to rats, was effective[N14740]. The hot water extract, in a preparation that also contained *Paeonia albiflora*, administered by gastric intubation at a dose of 18.0 mg/kg, was effective vs carrageenin-induced pedal edema and cotton pellet granuloma[T11694]. Hot water extract of the dried root, in a mixture containing 8 gm *Bupleurum* species, 3 gm each *Glycyrrhiza glabra*, *Panax ginseng*, *Ziziphus jujuba*, and *Scutellaria baicalensis*, 1 gm *Zingiber officinale*, and 8 gm *Pinellia ternata*, administered by gastric intubation to rats at a dose of 1.1 gm/kg, was effective vs carrageenin-induced pedal edema, results significant at p <0.05 level; vs cotton pellet granuloma, results significant at p <0.01 level[T09859]. The dried root, in a mixture containing *Bauhinia variegata* and *Commiphor mukul* was taken orally by 18 patients with rheumatic diseases. Eleven of the patients showed good, 4 showed moderate and 3 showed no relief[T07267]. Water extract of the dried root, administered intraperitoneally to rats at a dose of 3.0 gm/kg, was effective vs acetic acid-induced pedal edema[N13376]. The butanol and ether extracts of the root were not effective, and the water extract was effective in an albumin stabilizing assay[A02047].

Antijaundice effect. Decoction of the dried rhizome, taken orally by 120 patients with hepatitis B at a dose of 30 ml/person twice daily for approximately 60 days, was effective. The preparation used was a mixture of *Citrus reticulata* fresh leaf, *Astragalus membranaceus* root, *Similax china* rhizome, *Gardenia jasminoides* root, *Pueraparia lobata* root, *Curcuma aromatica* root, and *Vigna sinensis* pod. A total effective rate of 90% was demonstrated, 60% cured and 30% improved[M30710].

Antimalarial activity. Ethanol/water (1:1) extract of the dried root, at a concentration of 100.0 mcg/ml, inhibited *Plasmodium berghei* by 63%. A dose of 1.0 gm/kg, administered intragastrically to mice daily for 4 days, was not effective on *Plasmodium berghei*[M27524].

Antimutagenic activity. Ethanol (95%) extract of the dried rhizome, on agar plate at a concentration of 75.0 microliters/plate, was active on *Salmonella typhimurium* TA100 vs ribose-lysine-induced mutagenesis, and inactive vs ethyl methanesulfonate and n-methyl-n-nitroso-guanidine-induced mutagenesis[K16830]. Ethanol (95%) extract of the dried rhizome, on agar plate at variable concentrations, was active on *Salmonella typhimurium* TA100[M16692]. Infusion of the rhizome, on agar plate at a concentration of 100.0 microliters/disc, produced strong activity on *Salmonella typhimurium* TA98 vs 2-amino-anthracene-induced mutagenicity and TA100 vs ethyl methanesulfonate-induced mutagenicity. Metabolic activation was required for activity[K28100]. The powdered root, on agar plate at a concentration of 0.5 mg/plate, was active on *Salmonella typhimurium* TA100 vs aflatoxin B1-induced mutagenesis[A03634]. The root, on agar plate at a concentration of 7.5 mg/plate, was active on *Salmonella typhimurium* TA98 vs TRP-P-1 and TRP-P-2-induced mutation[T14055]. The root, on agar plate at a concentration of 50.0 mg/ml, was inactive on *Salmonella typhimurium* TA1535 vs mitomycin and aflatoxin-induced mutagenesis. Metabolic activation had no effect on the results[M29342]. Water extract of the dried root, on agar plate at variable concentrations, was inactive on *Salmonella typhimurium* TA100 and TA98 vs benzo[a]pyrene-induced mutagenesis[M28436]. Water extract of the dried root, on agar plate at a concentration of 300.0 mcg/plate, was active on *Salmonella typhimurium* TA100 and TA98. A decrease in mutation frequencies was induced by mutagens in modified Ames test with and without metabolic activation[J12382].

Antimycobacterial activity. Ethanol (80%) extract of the dried root, on agar plate at a concentration of 1.0 mg/ml, was active on *Mycobacterium smegmatis*[T07382]. Ethanol (95%) extract of the entire plant, in broth culture, was active on *Mycobacterium tuberculosis* H37RVTMC 102[M27150]. Ethanol (95%) extract of the root, on agar plate, was active on *Mycobacterium smegmatis*[N00846].

Antinematodal activity. Water extract of the dried bark, at variable concentrations, produced strong activity on *Meloidogyne incognita*[T07251].

Antinephroptosis activity. The root, taken orally by adults at a dose of 7.5 gm/day, was active. The study was conducted with 53 patients with nephroptosis. The patients showed improvement in lower back pain and subabdominal discomfort. Results were obtained using the composite extract of *Panax ginseng*, *Astragalus* species, *Atractylodes japonica*, *Angelica sinensis*, *Bupleurum falcatum*, *Zizyphus* species, *Cimicifuga simplex*, and *Zingiber officinales*[K14330].

Antinephretic effect. Decoction of the dried root, in a Japanese medicine, "TJ-8014", containing *Bupleurum falcatum* 7 gm root, *Pinellia ternata* 5 gm tuber, *Scutellaria baicalensis* 3 gm root, *Panax ginseng* 3 gm root, *Coptis chinensis* 1 gm rhizome, *Pachyma hoelen* 3 gm fruit, *Glycyrrhiza glabra* 2 gm root, and *Ziziphus vulgaris* 3 gm fruit, administered intragastrically to male rats at a dose

of 2–5.0 gm/kg, was active[M29539]. Decoction of the dried root, taken orally by 15 cases of chronic nephritis, 1 case of hypertensive nephritis, 8 cases of latent nephritis, 2 cases each of nephrotic syndrome types I and II and 2 cases of lupus nephritis, was active. The patients were treated with a syrup made from the decoction, at a dose of 10.0 ml/person 3 times a day for a period ranging from 2–10 months. The syrup also contained *Tripterygium wilfordii* and *Salvia miltiorrhiza*. Steroids were gradually withdrawn from the patients with type II nephrotic syndrome, but stopped in other patients. Proteinuria was improved in all of the patients. In 10 cases with proteinuria, the level was checked before and after treatment; proteinuria decreased from 4.1 to 1.4 gm/dl. Proteinuria completely disappeared in 12 patients. The onset of action was 2 to 3 weeks[M28436].

Antioxidant activity. Methanol extract of the dried root, administered intragastrically to mice at a dose of 0.16 gm/kg, was active vs ethanol-induced lipid peroxidation in mouse liver[M20450]. Methanol extract of the stem, at a concentration of 50.0 microliters, produced strong activity[K23609]. Polar lipid fraction of the dried rhizome, on agar plate at a concentration of 100.0 mcg/ml, was active on *Escherichia coli* vs illuminated rose bengal-induced oxygen radical formation[K07531].

Antioxytocic effect. Water extract of the dried root, in a mixture with *Pinellia ternata*, *Citrus aurantium*, *Pachyma hoelen*, and *Zingiber officinale*, at a concentration of 0.01 gm/ml, produced weak activity on a rat uterus vs oxytocin-induced contractions[T11368].

Antipruritic activity. Decoction of the dried root, taken orally by adults, was effective on a patient who was presented with a diagnosis of subsepsis allergica. The main clinical features were long-standing fever, arthralgia, leukocytosis, and rash. The patient was treated daily with the decoction for a period of 4 weeks. The treatment consisted of a Chinese prescription that also contained *Gentiana macrophylla* root, *Lycium chinensis* plant, *Bupleurum falcatum* root, *Angelica sinensis* root, *Anemarrhena asphodeloides* root, *Rehmannia glutinosa* root, and *Paeonia albiflora* root[M28622].

Antipyretic activity. A preparation that included 1.875 gm each of *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, and *Akebia* species, and 3.75 gm each of *Rehmannia glutinosa*, *Glycyrrhiza glabra*, and *Zingiber officinale*, administered to the rat at a dose of 1.0 gm/kg, was effective vs endotoxin-induced fever[M20428]. Hot water extract of the dried root, administered by gastric intubation to rabbits at a dose of 1.0 gm/kg, was effective vs typhoid vaccine-induced pyrexia[T09702]. The dried root, administered intragastrically to rats, was not effective vs pyrexia induced by the subcutaneous injection of yeast[A14888].

Antisecretory effect. Water extract of the dried root, administered intraperitoneally to rats at a dose of 0.1 gm/kg, was not effective, and a dose of 1.0 gm/kg was effective vs Shay-induced ulcers[N13376].

Antispasmodic activity. Ethanol (30%) extract of the root, at a concentration of 0.1%, was active on guinea pig ileum vs histamine- and ACh-induced spasms[T01446]. Ethanol (95%) extract of the root, at a concentration of 2.0 mg/ml, was active on the dog intestine vs ACh-induced spasms[A05480]. Ethanol (95%) extract of the root was active on the guinea pig intestine[A00358]. Water and methanol extracts of the dried root, at a concentration of 0.1 mg/ml, were active on the guinea pig ileum vs ACh-induced contractions[N13376]. Water extract of the dried root, in a mixture with *Pinellia ternata*, *Citrus aurantium*, *Pachyma hoelen*, and *Zin-*

giber officinale, at a concentration of 0.01 gm/ml, was active on the guinea pig and rabbit ileum and small intestine[T11368]. Water extract of the root was active on rabbit small intestine vs $BaCl_2$-induced contractions[A06746].

Antitoxic activity. The dried root, in broth culture at a dose of 1.0 gm/liter, was active on *Aspergillus flavus* vs urethane-induced narcosis. The production of aflatoxin was inhibited[T08142]. The root, in mixtures with *Catanospermum australe* and *Zingiber officinale*, administered by gastric intubation to mice at a dose of 350.0 mg/kg, were active vs treatment with alkaloid fractions of *Aconitum sibiricum*. A dose of 700.0 mg/kg of the dried root alone was active[T09184].

Antitumor activity. Acid/water, ethanol (95%), and water extracts of the powdered root, administered subcutaneously to mice of both sexes at a dose of 1.0 gm/kg, were inactive on Sarcoma 37[W03671]. Decoction of the dried rhizome, at variable dosage levels 3 times daily, was active in 11 cases of malignant lymphoma. The preparation used was a mixture of *Oldenlandia diffusa*, *Cremastra variabilis*, *Sparganium stoloniferum*, *Curcuma zedoaria*, *Atractylodes macrocephala*, *Prunella vulgaris*, *Laminaria japonica*, *Arca inflata*, *Dioscorea bulbifera*, pangolin scale and scorpion, silkworm and oyster shell[M30700]. Ethanol (95%) and water extracts of the dried root, administered intraperitoneally to mice at a dose of 100.0 mg/kg, were inactive and equivocal, respectively, on Sarcoma 180(ASC)[M23643]. Ethanol/water (1:1) extract of the dried root, administered intraperitoneally to mice at a dose of 170.0 mg/kg, was active on LEUK-P388[T10126]. Water extract of the dried root, in a preparation that also contained *Bupleurum falcatum*, *Pinellia ternata*, *Scutellaria baicalensis*, *Ziziphus jujuba*, *Panax ginseng*, and *Zingiber officinale*, administered by gastric intubation to mice at a dose of 300.0 mg/kg on days 1–10, was active on Leuk-L1210. The animals were also given either 5-fluorouracil or cytarabine. Results significant at $p < 0.05$ level. The same dose, administered intraperitoneally to mice, was inactive[T11351].

Antitussive activity. Ethanol (16%) extract of the dried root, in a mixture of alcoholic extract of *Stemona tuberosa* and clove oil, administered intraperitoneally to mice, was active vs cough induced by ammonia vapor[P00104].

Antiulcer activity. Deglycyrrhizinized extract of the dried root, administered by gastric intubation to rats at a dose of 2.0 gm/kg, was active vs aspirin- and bile-induced ulcers, results significant at $p < 0.005$ level and $p < 0.002$ level, respectively[T09776]. The root and stem, administered intragastrically to male rats, was active. The dose protected the gastric mucosa against aspirin damage. Deglycyrrhinized licorice and licorice with 15% glycyrrhizinic acid added showed the same effect[K19357]. Deglycyrrhizinized extract of the root, taken orally by 41 adult patients in a study to determine the ability to prevent recurrence of ulcers, was equivocal[M01055]. Ethanol (30%) extract of the root, administered orally to rats at a dose of 0.25 ml/kg, was active vs Shay rat test (30% reduction in ulceration)[T01446]. The water extract, administered by intravenous bolus dose, was inactive vs pylorus-ligated ulcers (Shay)[J09693]. Hot water extract of the dried root, administered by gastric intubation to mice at a dose of 1.589 gm/kg, was inactive on ulcers induced by stress [T04496]. The dried root was taken orally by adults in a study employing 15 cases of radiologically proven peptic ulcer. The results showed beneficial effects on symptomatology of peptic ulcer with radiological improvement in ulcer healing in more than 75% of the cases. There was minimal effect on gastric acid secretion[N02187]. Water extract of the dried rhizome, taken orally by adults at a dose of 380.0 mg/person 3 times daily, was active. Deglycirrhizinated

licorice was administered to 169 patients with chronic duodenal ulcers. No significant improvement in healing, compared with cimetidine, was observed[K07727]. Water extract of the dried root, administered intraperitoneally to rats at a dose of 0.1 gm/kg, was inactive, and a dose of 1.0 gm/kg was active vs Shay-induced ulcers [N13376]. Water extract of the dried root, in a mixture with *Pinellia ternata*, *Citrus aurantium*, *Pachyma hoelen*, and *Zingiber officinale*, administered intraperitoneally to rats at a dose of 1.0 mg/gm, was active vs Shay ulcers, results significant at $p < 0.01$ level[T11368].

Antiviral activity. Saponin fraction of the dried root, on embryonated chicken, produced strong activity on influenza virus A[W03697]. The dried root, at variable concentrations, was active on Spinach Mosaic virus[T14473]. Water and methanol extracts of the dried root, on agar plate at a concentration of 100.0 mcg/ml, were inactive on Herpes simplex I virus[K28424]. Water extract of the dried root, in cell culture at a concentration of 10.0 mg/mL, was inactive on Herpes virus type 2, Influenza virus A2 (Manheim 57), Poliovirus II, and Vaccinia virus[T09507].

Antiyeast activity. Ethanol (80%) extract of the dried root, on agar plate at a concentration of 1.0 mg/ml, was inactive on *Candida albicans*[T07382]. The ethanol (95%) extract was active[N00846]. Ethanol (95%) extract of the stem, on agar plate, was active on *Candida albicans*[W00232]. Ethanol/water (1:1) extract of the dried root, on agar plate at a concentration of 417.0 mg/mL, was inactive on *Candida albicans* and *Saccharomyces pastorianus*[T16238]. Saponin fraction of the dried root, on agar plate, was equivocal on *Candida albicans*, *Candida parasilosis*, *Candida pseudotropicalis*, and *Candida stellatoidea*, MIC 0.63%[K27726].

Arachidonate metabolism inhibition. Hot water extract of the dried root, in a mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng* in 700 mL of water, administered intragastrically to mice on days 1 to 3, was active[M20581].

Aspartate transaminase level decrease. Decoction of the dried rhizome, taken orally by 80 adults of both sexes with hepatitis B antigen positive chronic hepatitis for 6 months at a dose of 7.5 gm/day, was active. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Astringent effect. Acetone/water (70:30) extract of the dried rhizome was active vs binding to hemoglobin[T14957].

Atrial natriuretic peptide increase. Hot water extract of the dried root, taken orally by healthy adults at a dose of 100 gm (0.7 gm glycyrrhizic acid) daily for 8 weeks, produced an increase in plasma ANP correlated with weight gain but not blood pressure[M21430].

Barbiturate potentiation. A preparation that included 1.875 gm each *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, *Glycyrrhiza glabra*, and 3.75 gm *Zingiber officinale*, administered to the mouse at a dose of 1.0 gm/kg, was active[M20428]. The dried root, in a mixture containg *Paeonia* species, *Angelica gigas*, *Astragalus membranaceus*, *Cnidium officinale*, *Rehmannia glutinosa*, *Atractylodes* species, *Pueraria* species, *Cinnamomum cassia*, *Zingiber officinale*, *Ziziphus vulgaris*, and *Panax ginseng*, administered intragastrically to mice at a dose of 3.0 gm/kg, increased hexabarbital-induced sleeping time[M25858].

Benzopyrene hydroxylase induction. Water extract of the dried root, in the ration of mice at a concentration of 8.0% of the diet, was active[K11705].

Binding effect. Hot water extract of the dried root, in a mixture containing *Paeonia albiflora*, *Rehmannia glutinosa*, *Astragalus* species, *Angelica gigas*, *Selinum monnieri*, and *Cinnamomum* species, administered intragastrically to rats, was active vs binding of sulphobromophthalein to hepatic cytoplasmic protein[M20703].

BUN lowering effect. Water extract of the dried root, administered orally to rats at a dose of 0.2 gm/kg for 12 days, showed no inhibition of the elevation of plasma urea nitrogen in nephritic rats[K20129].

Calcium channel blocker. Decoction of the dried root, in a mixture with *Triticum aestivum* and *Ziziphus jujuba* at a concentration of 4.0%, was active on the snail neuron[M18551].

Carcinogenesis inhibition. Infusion of the dried root, in the drinking water of mice for 31 weeks, decreased lung and forestomach tumors by 26% and 55%, respectively, vs n-nitrosodiethylamine-induced carcinogenesis, and 20% and 60%, respectively, vs benzo[a]pyrene-induced carcinogenesis[K08654].

Catalase stimulation. The dried root, in combination with *Glycine max* in the ration of rats at a dose of 3.0% of the diet, was active[K09254].

Cell proliferation inhibition. Polar lipid fraction of the dried rhizome, on agar plate at a concentration of 200.0 mcg/ml, was inactive on *Escherichia coli*[M20458] .

Choleretic activity. Methanol extract of the dried root, administered intragastrically to rats at a dose of 0.2 gm/kg, was inactive[M16531]. Water extract of the dried root, administered intragastrically to rats at a dose of 6.278 gm/kg, was active on the gall bladder[J12401].

Cholesterol ester formation. Decoction of the dried rhizome, administered intragastrically to mice at a dose of 1.2 gm/kg, was inactive on macrophages. The study was conducted with a Kampoh, a prescription known as Shosaikoto, which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K08369].

Choline acetyltransferase induction. Powdered, dried root, in a kampo medicine 'Kami-untan-to', that contains dried *Pinellia ternata*, *Phyllostachys nigra*, *Citrus aurantium*, *Poria cocos*, *Citrus unshiu*, *Polygala tenuifolia*, *Scrophularia ningpoensis*, *Panax ginseng*, *Rehmannia glutinosa*, *Ziziphus jujuba*, and *Zingiber officinale* administered intragastrically to rats, was active on the brain[K24968].

CNS depressant activity. Hot water extract of the dried root, in a mixture containing *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus aurantium*, *Cimicifuga* species, and *Bupleurum* species, administered by gastric intubation to mice at a dose of 1.0 gm/kg, was active vs Rotarod test[T09702].

CNS effect. Water extract of the root, in a mixture containing *Zingiber officinale*, *Panax ginseng*, *Scutellaria baicalensis*, *Ziziphus jujuba*, *Pinellia ternata*, *Bupleurum falcatum*, *Cinnamomum cassia*, and *Paeonia albiflora*, administered by gastric intubation to mice at a dose of 4.0 gm/kg, was inactive. No change in the EEG, behavior, or the active and resting cycles was observed[T08515].

Common cold relief. Hot water extract of the dried root, in a preparation containing 5 grams each *Glycyrrhiza glabra*, *Viola odorata*, *Onosma bracteatum*, and *Lavendula stoechas*, soaked in 240 ml of water and then boiled, was taken orally by 43 adult patients with chronic sinusitis, at a dose of 120 ml twice daily. Eleven of the patients were relieved and 9 partially relieved[M11732]. The hot water extract, taken orally by adults at a dose of 20 gm/person, was effective[T14073].

Corticosteroid type activity. Hot water extract of the dried root, in a mixture con-

taining 8 gm *Bupleurum* species, 3 gm *Glycyrrhiza glabra*, 3 gm *Ziziphus jujuba*, 1 gm *Zingiber officinale*, 3 gm *Panax ginseng*, 8 gm *Pinellia ternata*, and 3 gm *Scutellaria baicalensis*, administered by gastric intubation to rats at a dose of 1.1 gm/kg, increased the plasma level of prednisolone[T09859].

Corticosterone induction. Hot water extract of the dried root, in a mixture containing 8 gm of *Bupleurum* species, 3 gm *Glycyrrhiza glabra*, 3 gm *Ziziphus jujuba*, 1 gm *Zingiber officinale*, 3 gm *Panax ginseng*, 8 gm of *Pinellia ternata*, and 3 gm *Scutellaria baicalensis*, administered by gastric intubation to rats at a dose of 1.1 gm/kg, was active, results significant at $p < 0.01$ level[T09859]. Decoction of the dried root, in a preparation containing *Bupleurum falcatum* 7 gm root, *Pinellia ternata* 5 gm tuber, *Scutellaria baicalensis* 3 gm root, *Panax ginseng* 3 gm root, *Coptis chinensis* 1 gm rhizome, *Pachyma hoelen* 3 gm fruit, *Glycyrrhiza glabra* 2 gm root, and *Ziziphus vulgaris* 3 gm fruit, administered intragastrically to rats at a dose of 0.5 gm/kg daily for 2 weeks after the injection of rabbit anti-rat GBM to produce nephritis, was active[M30495]. The hot water extract, administered intraperitoneally to rats at a dose of 200.0 mg/kg, produced an increase in serum and adrenal corticosterone vs carrageenin-induced pedal edema[T14823]. Water extract of the dried rhizome, administered intraperitoneally at a dose of 150.0 mg/kg to mice subjected to immobilizaton stress, was active[M20458].

Cortisol decrease. Hot water extract of the dried root, taken orally by healthy adults at a dose of 100.0 gm/day for 8 weeks, produced an increase in urine cortisol, but plasma cortisol was stable[M21430].

Cyclic AMP stimulation. Hot water extract of the dried root, in a mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng*, administered intraperitoneally to rats at a dose of 200.0 mg/kg, produced an increase in cyclic AMP levels in the pituitary and adrenal glands, but not in the hypothalamus. The increase was inhibited by dexamethasone[T14878].

Cyclic nucleotide phosphodiesterase inhibition. Chloroform and hot water extracts of the root, at a concentration of 100.0 mcg/ml, produced 72% inhibition[T04931].

Cytochrome P-450 induction. The root, administered intragastrically to mice of both sexes at a dose of 3.138 gm/kg, was active on the liver microsomes[J14578].

Cytotoxic activity. Ethanol/water (1:1) extract of the dried root, in cell culture at a concentration of 25.0 mcg/ml, was inactive on CA-9KB[T10126]. Water and methanol extracts of the dried root, on agar plate at a concentration of 100.0 mcg/ml, were inactive on Vero cells[K28424]. Water extract of the dried rhizome, in cell culture at a concentration of 250.0 mcg/ml, produced weak activity on CA-mammary-microalveolar, and a concentration of 500.0 mcg/ml was inactive on human embryonic HE-l cells [M26592]. Water extract of the dried root, in cell culture at a concentration of 10.0%, was inactive on Hela cells[T09507]. Water extract of the dried root, in cell culture at variable concentrations, was inactive on *Salmonella typhimurium* TA100 and TA98[M24807]. The hot water extract, at a concentration of 500.0 mcg/ml, was inactive on HE-I cells. The inhibition rate was 25%. A dose of 250.0 mcg/ml was active on CA-JTC-26 with an inhibition rate of 67%[M27219].

Degranulation inhibition. Hot water extract of the dried root, with a mixture of *Bupleurum falcatum*, *Pinellia ternata*, *Poria cocos*, *Scutellaria baicalensis*, *Ziziphus vulgaris*, *Panax ginseng*, *Magnolia obvata*, *Perilla frutescens* var. acuta, and *Zingiber officinale*, in cell culture at a concentration of 0.1 mg/ml, was active vs compound 48-40-induced degranulation of mast cells[M29006].

Desmutagenic activity. Ethanol (95%) extract of the dried rhizome, on agar plate at a concentration of 75.0 microliters/plate, was active on *Salmonella typhimurium* TA100 vs ribose-lysine, ethyl methanesulfonate and n-methyl-n-nitroso-guanidine-induced mutagenesis[K16830].

Diuretic activity. Hot water extract of the dried root, in a mixture containing *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus aurantium*, Cimicifuga species and *Bupleurum* species, administered by gastric intubation to mice at a dose of 500.0 mg/kg, was effective, results significant at p <0.01 level[T09705].

DNA polymerase alpha, beta and gamma inhibition. Water extract of the dried root, in a prescription known as 'Shosaikoto', which consists of 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng*, at a concentration of 500.0 mcg/ml, was active on reverse transcriptase from HIV[M31066].

DNA polymerase inhibition. The decoction of the root, at a concentration of 500.0 mcg/ml, was active on alpha and beta inhibition, and inactive on gamma inhibition. The study was conducted with a Japanese kampoh prescription known as 'Shosaikoto', which consists of *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* trunk, *Ziziphus jujuba* fruit, *Glycyrrhiza glabra* root, and *Panax ginseng* root[M27618].

DNA-binding inhibition. The root, at a concentration of 2.25 mg/ml, was active on the calf thymus DNA. The dose decreased the binding of aflatoxin B1 metabolites by 89%. Metabolic activation was required to obtain positive results[A00124].

Embryotoxic effect. Ethanol (40%) extract of the dried root, administered orally to pregnant rats and rabbits at a dose of 1.6 ml/kg, was inactive[T01997]. Ethanol (95%) extract of the dried root, administered by gastric intubation to pregnant rats at a dose of 250.0 mcg/kg, was equivocal[T08548].

Epstein-Barr virus early activation inhibition. The decoction and ether extract of the dried rhizome, in cell culture at a concentration of 5.0 mcg/ml, were active vs 12-0-tetradecanoylphorbol-13-acetate-induced early antigen activation. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Estrogenic activity. Acetone extract of the leaf, administered subcutaneously to infant mice, was active[A04826]. Ethanol (95%) extract of the aerial part, administered subcutaneously to immature, ovariectomized, infant and normal mice, was active. The activity was variable depending on the season of plant collection. Plants harvested in the autumn showed the highest activity[A05981]. Ethanol (95%) extract of the root, administered orally to ovariectomized rats, was inactive[A00124]. When administered subcutaneously to infant mice the extract was active [A04678], as was the petroleum ether extract[A00012]. Ethanol(95%) extract of the root, administered subcutaneously and water extract in the ration of infant mice[A00008] and ovariectomized rats[A06518] at a dose of 5.0 mg/animal, were active. The root, in the ration of infant female mice, was active. The effect was equivalent to 12,800 estrogen units/kg plant material[A04871].

Fertilization inhibition. Ethanol (40%) extract of the dried root, administered orally to female rats at a dose of 1.6 ml/kg, was not effective[T01997].

Gastric antisecretory activity. Ethanol (30%) extract of the root, at a concentration of 1.0% administered by perfusion to the female rat, produced no change in

pH[T01446]. Hot water extract of the dried root, in a mixture containing *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus aurantium*, *Cimicifuga* species, and *Bupleurum* species, administered by gastric intubation to mice at a dose of 500.0 mg/kg, was effective vs pylorus ligation-induced ulcers, results significant at p <0.001 level[T09705]. The root, administered orally to, rats showed no reduction in total acid level, but a decrease in free acid levels[N02187]. Water extract of the dried root, administered by gastric intubation to rabbits at a dose of 125.0 mg/kg, was effective. A mixture of *Pinellia ternata* rhizome, *Atractylis* species rhizome, *Citrus aurantium plant*, *Pachyma hoelen* fruit, *Panax ginseng* root, *Glycyrrhiza glabra* root, *Zingiber officinale* rhizome, and *Zizyphus jujuba* fruit was used[T09574]. Water extract of the dried root, in a mixture with *Pinellia ternata*, *Citrus aurantium*, *Pachyma hoelen*, and *Zingiber officinale*, administered intraperitoneally to rats at a dose of 0.5 mg/gm, was effective vs Shay ulcers[T11368].

Genitourinary effect. Water extract of the dried root, administered orally to rats at a dose of 0.2 gm/day for 12 days, did not affect the urinary protein excretion in nephretic rats. However, the treatment reduced hypercellularity of the glomeruli in the treated nephretic rats. A dose of 0.5 mg/kg of the mixture containing *Bupleurum falcatum* root, *Pinellia ternata* tuber, *Scutellaria baicalensis* root, *Panax ginseng* root, *Coptis chinensis* rhizome, *Pachyma hoelen* fruit, *Glycyrrhiza glabra* root, and *Ziziphus vulgaris* fruit, reduced hypercellularity and adhesion index in glomeruli. Urinary protein excretion was also lower[K20129].

Glucagon induction. A prescription containing *Gypsum fibrosum*, *Oryzae semen*, *Anemarrhenae rhizoma*, *Glycyrrhiza radix*, and *Panax ginseng* was active vs cyproheptadin-induced diabetes[M24251].

Glucuronyl transferase stimulation. Methanol extract of the dried root, administered intragastrically to rats at a dose of 1.0 gm/kg, was active[J11422,K23201].

Glutamate oxaloacetate transaminase inhibition. Hot water extract of the dried root, in a mixture containing *Paeonia albiflora*, *Rehmannia glutinosa*, *Astragalus* species, *Angelica gigas*, *Selinum monnieri*, and *Cinnamomum* species, administered intragastrically to rats, was inactive[M20703]. Methanol extract of the dried root in a mixture containing *Machilus* species, *Alisma* species, *Amomum xanthiodes*, *Bulboschoenus maritimus*, *Artemisia iwayomogis*, *Atractylodes japonica*, *Crataegus cuneata*, *Hordeum vulgar*, *Citrus sinensis*, *Polyporus umbellatus*, *Agastache rugosa*, *Raphanus sativus*, *Poncirus trifoliatus*, *Curcuma zedoaria*, *Citrus aurantium*, *Saussurea lappa*, and *Zingiber officinale*, administered by gastric intubation to rabbits at a dose of 0.5 gm/kg, was active vs CCl_4-induced hepatotoxicity, results significant at p <0.01 level[T08441]. Water extract of the dried root, in a mixture containing *Bupleurum laoi* root, *Pinellia ternata* tuber, *Scutellaria baicalensis* root, *Panax ginseng* root, *Ziziphus vulgaris* fruit, and *Zingiber officinale* rhizome, administered intraperitoneally to rats at a dose of 1.0 gm/kg, was active vs CCl_4-induced hepatotoxicity[M28210].

Glutamate pyruvate transaminase inhibition. Water extract of the dried root, in a mixture containing *Bupleurum laoi* root, *Pinellia ternata* tuber, *Scutellaria baicalensis* root, *Panax ginseng* root, *Ziziphus vulgaris* fruit, and *Zingiber officinale* rhizome, administered intraperitoneally to rats at a dose of 1.0 gm/kg, was active vs CCl_4-induced hepatotoxicity[M28210]. Hot water extract of the dried root, in a mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 2 gm *Glycyrrhiza glabra*, 1 gm *Zingiber officinale*, 3 gm *Panax ginseng*, and 3 gm *Ziziphus jujuba*in 700 ml of water, administered intragastrically to mice for 1 month, was active vs CCl_4-induced hepatotoxicity and galac-

tosamine-induced toxicity[M20760]. Methanol extract of the dried root, in a mixture containing *Machilus* species, *Alisma* species, *Amomum xanthiodes*, *Bulboschoenus maritimus*, *Artemisia iwayomogis*, *Atractylodes japonica*, *Crataegus cuneata*, *Hordeum vulgar*, *Citrus sinensis*, *Polyporus umbellatus*, *Agastache rugosa*, *Raphanus sativus*, *Poncirus trifoliatus*, *Curcuma zedoaria*, *Citrus aurantium*, *Saussurea lappa*, and *Zingiber officinale*, administered by gastric intubation to rabbits at a dose of 0.5 gm/kg, was active vs CCl_4-induced hepatotoxicity, results significant at p <0.01 level[T08441]. Hot water extract of the dried root, in a mixture containing *Paeonia albiflora*, *Rehmannia glutinosa*, *Astragalus* species, *Angelica gigas*, *Selinum monnieri*, and *Cinnamomum* species, administered intragastrically to rats, was inactive[M20703].

Glutamate oxaloacetate transaminase inhibition. Hot water extract of the dried root, in a mixture of 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng*, administered intraperitoneally to rats at a dose of 200.0 mg/kg, suppressed increase in serum GPT because of d-galactosamine-induced liver injury vs d-galactosamine-induced hepatotoxicity [T14824]. Hot water extract of the root, in combination with *Bupleurum falcatum*, *Zingiber officinale*, *Scutellaria baicalensis*, *Pinellia ternata*, *Ziziphus jujuba*, *Glycyrrhiza glabra*, and *Panax ginseng*, administered by gastric intubation to rats at a doses of 100.0 and 400.0 mg/kg, were active vs CCl_4-induced hepatotoxicity. Methionine, 100 mg/kg, was added, results significant at p <0.01 level[T11122].

Glutamate pyruvate transaminase inhibition. Hot water extract of the dried root, in a mixture of 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng*, administered intraperitoneally to rats at a dose of 200.0 mg/kg, suppressed increase in serum GPT because of d-galactosamine-induced liver injury. The effect was not seen in adrenalectomized rats vs d-galactosamine-induced hepatotoxicity[T14824]. Hot water extract of the root, in combination with *Bupleurum falcatum*, *Zingiber officinale*, *Scutellaria baicalensis*, *Pinellia ternata*, *Ziziphus jujuba*, *Glycyrrhiza glabra*, and *Panax ginseng*, administered by gastric intubation to rats at doses of 100.0 and 200.0 mg/kg, were active vs CCl_4-induced hepatotoxicity, results significant at p <0.01 level[T11122].

Glutathione formation induction. Polar lipid fraction of the dried rhizome, on agar plate at a concentration of 100.0 mcg/ml, was active on *Escherichia coli*[K07531].

Glutathione-s-transferase induction. Dried root, in combination with *Glycine max* in the ration of rats at a dose of 3.0% of the diet, was active[K09254]. Water extract of the dried root, in the ration of mice at a concentration of 8.0% of the diet, was active [K09254]. Hot water extract of the dried root, in a mixture containing *Paeonia albiflora*, *Rehmannia glutinosa*, *Astragalus* species, *Angelica gigas*, *Selinum monnieri*, and *Cinnamomum* species, administered intragastrically to rats, was inactive[M20703].

GRAS status. *Glycyrrhiza glabra* has been approved as a flavoring agent, not as a component of sugar substitutes, allowable up to 9.5% ash basis[T15572]. The root was approved safe as a flavoring agent by the United States Food and Drug Administration in 1976 (sect.582.10)[K00040].

Hepatitis antigen expression inhibition. Decoction of the dried rhizome was administered orally to 80 adults of both sexes with hepatitis B antigen positive chronic hepatitis, at a dose of 7.5 mg/day for 6 months. Eight of the patients seroconverted to anti-hepatitis B antibody, 15 became seronegative and 11 had a decrease of hepatitis B anti-

gen levels of more than 50%. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Histamine release inhibition. Hot water extract of the dried root, in a mixture containing *Bupleurum falcatum*, *Pinellia ternata*, *Poria cocos*, *Scutellaria baicalensis*, *Ziziphus vulgaris*, *Panax ginseng*, *Magnolia obvata*, *Perilla frutescens* var. acuta, and *Zingiber officinale*, in cell culture at a concentration of 0.1 mg/ml, was active vs compound 48-40-induced histamine release[M29006]. Hot water extract of the dried root, at a concentration of 5.0 mg/ml produced strong activity on the rat mast cells vs inhibition of histamine release induced by concanavalin A and compound 48/80. The assay was to predict antiinflammatory activity[T08540].

Histamine release stimulation. Water extract of the dried rhizome, administered intraperitoneally to mice subjected to immobilization stress at a dose of 150.0 mg/kg, was active[M20458].

Hydroxysteroid (II beta) dehydrogenase inhibition. Water extract of the dried rhizome, taken orally by adults at a dose of 100.0 gm/person daily for 8 weeks, was active[K15582]. Water extract of the dried root, taken orally by adults, inhibited the conversion of cortisol to cortisone. In the kidney, this conversion protects the mineralcorticoid receptor from cortisol[K07503]. A mixture containing *Bupleurum falcatum*, *Pinellia ternata*, *Poria cocos*, *Scutellaria baicalensis*, *Ziziphus vulgaris*, *Panax ginseng*, *Magnolia officinalis*, *Glycyrrhiza glabra*, *Perilla frutescens*, and *Zingiber officinale* produced strong activity[K17195].

Hypernatremia activity. Hot water extract of the dried root, taken orally by healthy adults at a dose of 100.0 gm/day for 8 weeks, was active[M21430].

Hypertensive activity. A case was reported of a 38 year-old woman who was hospitalized because of hypertension and hypokalemia after eating 200.0 gm of licorice daily [J13291]. Hot water extract of the dried root, taken orally by healthy adults at a dose of 100.0 gm/day for 8 weeks, produced mild hypertension that was normalized 2 weeks after dosing ended[M21430]. Water extract of the dried root, in a mixture containing the roots of *Angelica koreana*, *Peucedanum japonicum*, *Angelica gigas*, *Lindera strychnifolia*, *Angelica dahurica*, and *Asiasarum* species, the rhizome of *Cnidium officinale*, *Pinellia ternata*, *Cyperus rotundus*, and *Zingiber officinale*, with branches of *Cinnamomum cassia*, fruit of *Pachyma hoelen*, and *Citrus aurantium*, administered intravenously to rats at a dose of 1.5 mg/kg, was effective. A vasopressor and then a vasodepressor response occurred following administration of the extract. Hypotensive response was blocked by the administration of propranolol and atropine but not by chlorisondamine, prazosin, and cyproheptadine[M26285]. Water extract of the rhizome, taken orally by adults at variable dosage levels, was effective[M31333]. Water extract of the root, taken orally by human adults, was effective[M00186].

Hypocholesterolemic activity. A prescription containing *Gypsum fibrosum*, *Oryzae semen*, *Anemarrhenae rhizoma*, *Glycyrrhizae radix*, and *Panax ginseng* was effective vs cyproheptadine-induced diabetes[M24251].

Hypokalaemic activity. A 62 year-old man demonstrated hypokalemic effect and generalized weakness and pain after the ingestion 100.0 gm of rhizome[M26664]. A case was reported of a 29 year-old bulemic female who ingested 300–600 gm of the dried rhizome daily[K27186]. Hot water extract of the dried root, taken orally by healthy adults at a dose of 100.0 gm/day for 8 weeks, was effective[M21430]. A report describes 2 cases of hypokalemia induced by licorice flavoured chewing gum presenting symptoms of hyper-

tension and edema[K28964]. A review documented 59 cases of glycyrrhizin-induced hypokalemic myopathy that include onset factors, clinical manifestations and laboratory assessments showing that licorice ingestion and combined use of hypotensive diuretic agents increased risk. The main symptoms were flaccid quadriplegia. Complete cure was attained in 57 patients after discontinuation of licorice ingestion[J13228]. Water extract of the root, taken orally by a woman 58 years of age at a dose of 1.8 kg/week, was effective. The patient was admitted to hospital because of weakness in limbs and tiredness[M01047].

Hypolipemic activity. A prescription containing *Gypsum fibrosum*, *Oryzae semen*, *Anemarrhenae rhizoma*, *Glycyrrhizae radix*, and *Panax ginseng* was effective vs cyproheptadine-induced diabetes[M24251].

Hypotensive activity. Hot water extract of the dried root, in a mixture containing *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus aurantium*, *Cimicifuga* species, and *Bupleurum* species, administered by gastric intubation to rabbits at a dose of 100.0 mg/kg, was effective[T09705]. A preparation that included 1.875 gm each of *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, *Glycyrrhiza glabra*, and 3.75 gm *Zingiber officinale*, administered to the rabbit at a dose of 50.0 gm/kg, was effective[M20428]. Water extract of the dried rhizome and root taken, orally by 30 normotensive healthy adults at a dose of 100.0 gm/person, was effective[J12420].

Hypotriglyceridemia activity. A prescription containing *Gypsum fibrosum*, *Oryzae semen*, *Anemarrhenae rhizoma*, *Glycyrrhizae radix*, and *Panax ginseng* was active vs cyproheptadine-induced diabetes[M24251].

Immunomodulator activity. A medication containing *Glycyrrhiza glabra* root, *Panax ginseng* root, *Bupleurm falcatum* root, *Scutellaria baicalensis* root, *Zingiber officinale* rhizome, *Pinellia ternata* tuber, and *Ziziphus vulgaris* fruit, administered orally to mice at a dose of 89.0 mg/kg, suppressed the mitogenic activity of phytohemagglutinin and phorbol myristate acetate. A prescription containing *Glycyrrhiza glabra* root, *Panax ginseng* root, *Paeonia lactiflora* root, *Angelica acutiloba* root, *Atractylodes japonica* rhizome, *Cnidium officinale* rhizome, *Poria cocos* root, *Astragalus membranceus* root, *Cinnamomum cassia*, and *Rehmannia glutinosa* root, administered orally to rats at a dose of 11.0 mg/kg, had no effect on the mitogenic activity of lipopolysaccharide. The mitogenic activity of phorbol myristate acetate and phytohemagglutinin were elevated. At a dose of 17.8 mg/kg, the mitogenic activity of lipopolysaccharide was elevated and the activities of phorbol myristate acetate and phytohemagglutinin were elevated. A prescription containing *Glycyrrhiza glabra* root, *Panax ginseng* root, *Bupleurum falcatum* root, *Scutellaria baicalensis* root, *Angelica acutiloba* root, *Atractylodes japonica* rhizome, *Astragalus membranaceus* root, *Citrus unshiu* pericarp, and *Cimifuga simplex* rhizome, at a dose of 86.7 mg/kg, produced elevation in the mitogenic activity of lipopolysaccharide, phorbol myristate acetate, and phytohemagglutinin[T15280]. The dried root, administered intraperitoneally and intragastrically to mice, produced an inhibitory effect on humoral immune response to T-dependent antigen in sheep erythrocyte, delayed hypersensitivity, endogenous colony formation and phagocytic activity[K15610].

Immunostimulant activity. Decoction of the dried root, in the preparation Ninjinypuei-to which is comprised of *Rehmannia glutinosa*, *Angelica acutiloba*, *Atractylodes japonica*, *Poria cocos*, *Panax ginseng*, *Cinnamomum cassia*, *Polygala tenuifolia*, *Paeonia albiflora*, *Citrus unshui*, *Astragalus membranaceus*, *Glycyrrhiza glabra*, and *Schisandra*

chinensis, administered intraperitoneally to male mice at a dose of 2.0 mg/kg, caused an induction of neutrophil accumulation[M30683]. Water extract of the dried root was administered intravenously to 18 patients with subacute hepatic failure due to viral hepatitis at doses of 40 or 100 ml daily for 30 days, followed by 3 doses weekly for 8 weeks. The survival rate of patients was 72.2% vs 31.1% in control group patients. The patients showed improvement of ascites. Associated infections were observed in 2 of the 13 survivors and 4 of 5 patients who died. Adverse effects were not observed in any of the patients during therapy[K13101].

Immunosuppressant activity. Water extract of the dried root, administered intragastrically to mice at a dose of 5.0 gm/kg, was inactive[K18999]. Water extract of the dried root, at a concentration of 12.5 mg/ml, was equivocal on human lymphocytes. Evaluation was by depression of blastogenic response to phytohemagglutinin[T02391].

Insulin induction. Hot water extract of the dried root, in the ration of mice at a dose of 6.25% of the diet, was inactive vs streptozotocin-induced hyperglycemia[M24255].

Insulin release inhibition. A prescription containing *Gypsum fibrosum*, *Oryzae semen*, *Anemarrhenae rhizoma*, *Glycyrrhizae radix*, and *Ginseng radix* was active vs cyproheptadine-induced diabetes[M24251].

Interferon induction stimulation. Decoction of the dried rhizome, in cell culture at a concentration of 100.0 mcg/ml, was active on mouse splenocytes. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root. When administered intraperitoneally to mice at a dose of 250.0 mg/kg, the decoction was also active [K13115]. Decoction of the dried root, in a prescription containing *Glycyrrhiza glabra* root, *Panax ginseng* root, *Bupleurum falcatum* root, *Scutellaria baicalensis* root, *Zingiber officinale* rhizome, *Pinellia ternata* tuber, and *Ziziphus vulgaris* fruit, in cell culture at a concentration of 100.0 mcg/ml, was active. The peripheral lymphocytes from 8 patients with chronic active hepatitis, 4 with HBEAG and 4 with anti-HBE, were cultured with the extract[K07057]. Hot water extract of the root, in a mixture containing *Bupleurum chinense*, *Pinellia ternata*, *Scutellaria baicalensis*, *Ziziphus jujuba*, *Panax ginseng*, and *Zingiber officinale*, administered intraperitoneally to mice at a dose of 100.0 mg/kg, was active vs polymyxin B-induced interferon secretion inhibition[M24197].

Interleukin-I, II, III & VI formation stimulation. Decoction of the dried aerial parts, in cell culture, was active on peripheral blood monocytes from healthy adults. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785]. When administered intraperitoneally to mice at a dose of 250.0 mg/kg, the decoction was active [K13115].

Intestinal motility inhibition. Hot water extract of the dried root, in a mixture containing *Astragalus membranaceus*, *Panax ginseng*, *Atractylodes* species, *Angelica gigas*, *Citrus aurantium*, *Cimicifuga* species, and *Bupleurum* species, administered by gastric intubation to mice at a dose of 1.0 gm/kg, was effective vs charcoal meal intestinal transport assay, results significant at $p < 0.001$ level[T09705]. Water extract of the dried root, in a mixture with *Pinellia ternata*, *Citrus aurantium*, *Pachyma hoelen*, and *Zingiber officinale*, administered by gastric intubation to rabbits at a dose of 100.0 mg/kg, was effective[T11368].

Irradiation effect. Methanol extract of the dried root, administered intraperitoneally

to mice at a dose of 400.0 mg/kg, was active vs soft x-ray irradiation at lethal dose[T14342].

LDL oxidation inhibition. Alcohol extract of the root was active on the ovariectomized hamster, IC_{50} 1.8 mg/liter vs $CuSO_4$-induced formation of MDA equivalents in the plasma. The extract was also active on human adults, IC_{50} 2.2 mg/liter vs $CuSO_4$-induced formation of lipid peroxides. When administered through the drinking water of atherosclerotic mice at a dose of 200.0 mcg/day, the extract was active vs $CuSO_4$-induced LDL oxidation, results significant at $p < 0.01$ level. The extract was active on LDL isolated from 10 healthy subjects, treated for 2 weeks with the extract (lanox softgels) at a dose of 100.0 mg/day. The patients were subjected to oxidation by incubation with $CuSO_4$ or 2,2'-azobis 2-amidino propane hydrochloride[J13941].

Leukopenic activity. A mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng*, administered intraperitoneally to rats at a dose of 200.0 mg/kg, was active vs carrageenin-induced pleurisy[T14878].

Leukotriene B-4 production inhibition. Decoction of the dried rhizome, at a concentration of 50.0 mcg/ml, was active on macrophages vs calcium ionophore-induced leukotriene B-4 production. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Lipid metabolism effects. Decoction of the dried rhizome, administered intragastrically to mice at a dose of 1.2 gm/kg, increased the uptake of ox-LDL 1.6 times. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Lipid mobilization inhibition. Water extract of the dried root, in combination with *Paeonia albiflora*, at a dose of 90.0 mg/kg, was effective. The animals were sterilized by injection of testosterone subcutaneously at 2 days of age. The extract was administered daily for 2 weeks. Estradiol/testosterone ratio increased. The effect was not seen in the oophorectomized animals[M30730].

Lymphocyte blastogenesis inhibition. Water extract of the dried root, in cell culture at a concentration of 125.0 mcg, was inactive on human lymphocytes[T07814].

Lymphocyte blastogenesis stimulation. Water extract of the dried root, in cell culture at a concentration of 125.0 mcg, was inactive on human lymphocytes[T07814].

Macrophage activation. A mixture containing *Glycyrrhiza glabra* root, *Panax ginseng* root, *Bupleurum falcatum* root, *Scutellaria baicalensis* root, *Zingiber officinale* rhizome, *Pinellia ternata* tuber, and *Ziziphus vulgaris* fruit, administered intraperitoneally to mice, was active[T14857].

Macrophage cytotoxicity enhancement. A preparation containing *Bupleurum falcatum*, *Pinellia ternata*, *Scutellaria baicalensis*, *Ziziphus vulgaris*, *Panax ginseng*, *Glycyrrhiza glabra*, and *Zingiber officinale*, administered by gastric intubation to mice at a dose of 600.0 mg/kg, was inactive on Leuk-L1210[T11351].

Melanin formation inhibition. Fat soluble extract of the dried root, in cell culture, inhibited the uptake of labeled thiouracil in Melanoma-B16. The activity is highly dose-dependent[K23645]. Water extract of the dried root, at a concentration of 0.1%, was effective. The biological activity reported has been patented[K23960].

Membrane fluidity increase. Hot water extract of the dried root, in a mixture con-

taining 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng* in 700 ml of water, administered intragastrically to mice, was active vs membrane fluidity of macrophage[M20581].

Membrane stabilization effect. Decoction of the dried root, in a mixture with *Tricticum aestivum* and *Ziziphus jujuba* at a concentration of 4.0%, was active on the snail neuron vs pentylenetetrazol-induced bursting[M18551].

Memory retention improvement. Decoction of the dried root, in a mixture containing *Glycyrrhiza glabra* root, *Saussurea lappa* root, *Ziziphus jujuba* var. inermis fruit, *Zingiber officinale* rhizome, *Ziziphus jujuba* seed, and *Euphoria longana* aril, administered intragastrically to male mice at a dose of 1.0 gm/kg, was active. There was amelioration of memory registration impairment induced by ethanol in step through and step down tests[M27585]. The powder of a Kampo medicine, 'Kami-untan-to', containing *Pinellia ternata*, *Phyllostachys nigra*, *Citrus aurantium*, *Poria cocos*, *Citrus unshiu*, *Polygala tenuifolia*, *Scrophularia ningpoensis*, *Panax ginseng*, *Rhemannia glutinosa*, *Ziziphus jujuba*, and *Zingiber officinale*, administered intragastrically to rats, was active[K24968].

Menstruation induction effect. Hot water extract of a decoction of 31.25 gm *Glycyrrhiza glabra* root, and 6.24 gm *Panax ginseng* root per 200–300 ml dose, taken orally by adults with amenorrhea due to hypopituitarism daily for 30 days and 20 additional days, at a reduced dose level, was active[W03993].

Metabolism inhibition. The root, at a concentration of 45 mg/ml, inhibited the formation of organosoluble metabolites of aflatoxin B1. Metabolic activation was required to obtain positive results[M30420].

Mineral balance effect. Water extract of the dried root, taken orally by adults at variable dosage levels, was active. A man 70 years of age consumed 60 to 100 grams of licorice daily for 4 to 5 years. Evaluation revealed the patient to have hypertension, hypokalemia and increased sodium levels. Plasma renin, aldosterone and urinary aldosterone levels fell to low levels[K07495].

Mineralocorticoid type activity. Water extract of the dried rhizome, taken orally by human adults at a dose of 10.65 gm/person daily for 4 weeks, produced hypertension, hypokalemia, peripheral edema and depressed renin levels in patients with sub-clinical disease or using oral contraceptives[K17032].

Miscellaneous effects. Methanol extract of the dried root, in a mixture containing *Machilus* species, *Alisma* species, *Amomum xanthiodes*, *Bulboschoenus maritimus*, *Artemisia iwayomogis*, *Atractylodes japonica*, *Crataegus cuneata*, *Hordeum vulgar*, *Citrus sinensis*, *Polyporus umbellatus*, *Agastache rugosa*, *Raphanus sativus*, *Poncirus trifoliatus*, *Curcuma zedoaria*, *Citrus aurantium*, *Saussurea lappa*, and *Zingiber officinale*, administered by gastric intubation to rabbits at a dose of 500.0 mg/kg, was active vs CCl_4-induced hepatotoxicity. A decrease in bromosulphathalein accumulation in the blood and an increase in serum albumin and protein content were observed, results significant at $p < 0.01$ level[T08441].

Mitogenic activity. Decoction of the dried rhizome, in cell culture at a concentration of 100.0 mcg/ml, was active on mouse splenocytes. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785]. Hot water extract of the dried root, in a mixture with *Bupleurum falcatum*, *Pinellia ternata*, *Scutellaria baicalensis*, *Ziziphus vulgaris*, *Panax ginseng*, and *Zingiber officinale*, at a concentration of 10.0 mcg, was active on the mouse

splenocytes. When the extract mixture was added directly to the medium of spleen cells, an increase in mitogenic activity of lipopolysaccharide was observed. However, in the experimental system without lipopolysaccharide, the extract mixture itself showed activity; also, at an extract mixture concentration of 100 mcg, mitogenic activity was inhibited and cell viability was decreased remarkably. At a dose of 3.60 gm/kg, the extract mixture was first orally administered to mice and then the serum of the treated animals was tested for activity. An increase in mitogenic activity of lipopolysaccharide was observed. In the same experimental system without lipopolysaccharide, mitogenic action was not recognized in the spleen cells of the extract mixture-treated mice cells[T16190].

Monamine oxidase inhibition. Water extract of the dried rhizome, at a concentration of 30.0 mcg/ml, was active[M28190]. Water extract of the dried root, at a dose of 30.0 mcg/ml, was active[M28190].

Monooxygenase induction. The root, administered intragastrically to mice of both sexes at a dose of 6.2 gm/day, was active on the liver vs CYP-dependent monooxygenases. The result was observed after repeated dosings[J14578].

Mutagenic activity. Ethanol (95%) extract of the dried root, on agar plate at a concentration of 10.0 mg/plate, was inactive on *Salmonella typhimurium* TA98 and TA100[K08041]. Ethanol (95%) extract of the root, administered intravenously to dogs at a dose of 800.0 mg/kg, was inactive[A05480]. Hot water and methanol extracts of the root, on agar plate at a concentration of 50.0 mg of plant material/disc, were inactive on *Salmonella typhimurium* TA100 and TA98. The effect was the same with or without metabolic activation. Histidine was removed from the extract prior to testing[T06535]. Water extract of the dried root, on agar plate, was inactive on *Salmonella typhimurium* TA100 and TA98 preincubated with S9 mix from PCB-induced rats[M24807].

Natural killer cell enhancement. Polysaccharide fraction of the root, administered intragastrically to mice at a dose of 1.0 gm/kg, produced weak activity vs mononuclear cells incubated with YAC-I cells[J10712].

Nematocidal activity. Decoction of the rhizome, at a concentration of 10.0 gm/ml, was inactive on *Toxacara canis*[M26175]. Water extract of the dried rhizome, at a concentration of 10.0 mg/ml, was active, and the methanol extract, at a concentration of 1.0 mg/ml, was inactive on *Toxacara canis*[M28316].

Nerve growth factor stimulation. A Kampo medicine 'Kami-untan-to' containing *Pinellia ternata, Phyllostachys nigra, Citrus aurantium, Poria cocos, Citrus unshiu, Polygala tenuifolia, Scrophularia ningpoensis, Panax ginseng, Rehmannia glutinosa, Ziziphus jujuba,* and *Zingiber officinale*, administered intragastrically to rats, was active on the brain[K24968].

Ornithine decarboxylase inhibition. The dried root, in combination with *Glycine max* in the ration of rats at a dose of 0.38% of the diet, was active[K09254].

Ovulation inhibition. Ethanol (40%) extract of the dried root, administered orally to rats at a dose of 1.6 ml/kg, was inactive[T01997].

Oxygen radical inhibition. Decoction of the dried root, at a concentration of 17.0 mcg/ml, was inactive on the guinea pig macrophages vs inhibition of FMLP-induced superoxide anion. The decoction of a traditional Chinese medicine, 'Juzentaihoto', composed of *Astragalus mongoholicus, Cinnamomum cassia, Rehmannia glutinosa, Paeonia albiflora, Cnidium monnieri, Angelica sinensis, Atractylodes lancea, Panax ginseng, Poria cocos*, and *Glycyrrhiza glabra*, at a concentration of 500.0 mcg/ml, was active on the guinea pig macrophages[M29253]. Polar lipid fraction of the dried rhizome, on agar plate at a concentration of 100.0 mcg/ml, was active on *Escherichia coli* vs illuminated rose

bengal-induced oxygen radicals[K07531]. The root, at a concentration of 10.0 mg/liter, was active vs DPPH assay[J13941].

Pancreatic secretion stimulation. Methanol extract of the rhizome, administered to dogs intraduodenally at a dose of 0.5 gm/animal and intragastrically at a dose of 2.0 gm/animal, as active[M18099]. Water and methanol extracts of the dried root, administered intraduodenal to male rats at doses of 100.0 mg/kg and 50.0 mg/kg, respectively, produced strong activity[N05481].

Penile erectile stimulant. Extract of the dried stem, taken orally by adults, showed improvement in erection, duration of coitus and post-coital satisfaction in 56 cases treated for 4 weeks[T14366].

Pepsin inhibition. Water extract of the dried root, administered by gastric intubation to rabbits at a dose of 125.0 mg/kg, was active. A mixture of *Pinellia ternata* rhizome, *Atractylis* species rhizome, *Citrus aurantium* plant, *Pachyma hoelen* fruit, *Panax ginseng* root, *Glycyrrhiza glabra* root, *Zingiber officinale* rhizome, and *Zizyphus jujuba* fruit was used, results significant at $p < 0.05$ level[T09574].

Phagocytosis capacity increased. Hot water extract of the dried root, in a mixture of 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng* in 700 ml of water, administered intragastrically to mice, was active[M20581].

Pharmacokinetic study. The bioavailability of glycyrrhizin was much decreased when given in extract form with equivalent amount of compound, when compared to giving pure compound[K26801]. The decoction of the dried rhizome, taken orally by 5 normal adults at a concentration of 5%, reached maximum serum concentrations of glycyrrhetic glycosides at 4 hours post ingestion and was eliminated within 72 hours. Glycyrrhetic acid reached maximum serum concentration 24 hours post ingestion. The highest concentration was 30 ng/ml, and excretion was not completed after 96 hours in 2 of the subjects. In 2 cases of pseudoaldosteronism the serum glycyrrhetic acid levels were as high as 70-80 ng/ml while glycosides were quite low[K13115]. Water extract of the dried root, administered intragastrically to rats at a dose of 6.278 gm/kg, was excreted in the bile, reaching maximum by 8 hours after dosing[J12401].

Phosphodiesterase inhibition. Hot water extract of the stem, at a concentration of 1.0 mg/ml, was active[K28931].

Phospholipase A2 inhibition. Decoction of the dried rhizome, at a concentration of 100.0 mcg/ml, was active on macrophages and splenocytes. The study was conducted with a Kampoh, a prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[K13785].

Plaque formation suppressant. Water extract of the root was inactive on *Streptococcus mutans*, IC_{50} >1000 mcg/ml. The methanol and methanol/water (1:1) extracts were active, IC_{50} 10.0 mcg/ml and 20.0 mcg/ml, respectively[T11789].

Platelet aggregation stimulation. Hot water extract of the dried root, in a mixture containing *Zingiber officinale*, *Panax ginseng*, *Citrus aurantium*, and *Atractylodes japonica*, was active on human platelets[T15353].

Potassium channel blocking activity. Decoction of the dried root, in a mixture with *Tricticum aestivum* and *Ziziphus jujuba*, at a concentration of 4.0%, was active on the snail neuron[M18551].

Potassium depletion. Water extract of the rhizome, taken orally by adults at variable dosage levels, was active[M31333].

Prolactin stimulation. A 22 year-old patient suffering from licorice intoxication had symptoms such as headache, vomiting, photophobia and subsequently hyperprolactin-

emia and hypogonadism, indicating toxicity of cerebral functions[T01704].

Prostaglandin synthetase inhibition. Hot water extract of the dried root, in a mixture of 7 gm *Bupleurum falcatum*, 5 gm *Pinellia ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm Glycyrrhiza *glabra*, and 3 gm *Panax ginseng* in 700 ml of water, administered intragastrically to mice, was active[M20581].

Protein kinase stimulation. The dried root, in combination with *Glycine max* in the ration of rats, at doses of 3.0% and 0.38% of the diet, were active[K09254].

Protein synthetasis inhibition. Hot water extract of the dried root, in a mixture containing *Paeonia* species, *Angelica gigas*, *Astragalus membranaceus*, *Cnidium officinale*, *Rehmannia glutinosa*, Atractylodes species, *Pueraria* species, *Cinnamomum cassia*, *Zingiber officinale*, *Ziziphus vulgaris*, and *Panax ginseng*, administered intragastrically to mice and rats, was inactive[M25858].

Prothrombin time decrease. Hot water extract of the dried root, in a mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinellia ternata*, 3 gm *Scutellaria baicalensis*, 2 gm *Glycyrrhiza glabra*, 1 gm *Zingiber officinale*, 3 gm *Panax ginseng*, and 3 gm *Ziziphus jujuba* in 700 ml of water, administered intragastrically to mice for 1 month, was active vs CCl_4-induced hepatotoxicity[M20760].

Renal function improvement. Decoction of the dried root was taken orally by 15 adults with chronic renal failure due to chronic glomerulonephritis, polycystic disease, TB or diabetes enrolled in the study. The patients were dosed 3 times daily for 3 months with the combination of the extract and *Rehum officinale*. Improvements were seen in BUN, edema, fatigue, nausea, and constipation, without effect on hematocrit or albumin. The effect decreased after 6 months[K14322].

Renin inhibition. Hot water extract of the dried root, taken orally by healthy adults at a dose of 100.0 gm/day for 8 weeks, indicated a decrease in plasma renin for the first 4 weeks[M21430]. Water extract of the rhizome, taken orally by adults at variable dosage levels, was active[M31333].

Reverse transcriptase inhibition. Decoction of the rhizome, in cell culture at a concentration of 100.0 mcg/ml, was inactive on the lymphocytes of AIDS patients, and a concentration of 50.0 mcg/ml was active on lymphocytes from asymptomatic HIV positive and ARC patients. The study was conducted with a Kampoh prescription known as 'Shosaikoto', which consists of *Glycyrrhiza glabra* rhizome, *Bupleurum falcatum* root, *Zingiber officinale* rhizome, *Scutellaria baicalensis* root, *Pinellia ternata* tuber, *Ziziphus jujuba* fruit, and *Panax ginseng* root[M27622]. Water extract of the dried root, in a prescription containing *Glycyrrhiza glabra* root, *Panax ginseng* root, *Bupleurum falcatum* root, *Scutellaria baicalensis* root, *Zingiber officinale* rhizome, *Pinellia ternata* tuber, and *Ziziphus vulgaris* fruit, at a concentration of 200.0 mcg/ml, showed positive reverse transcriptase activity on the Moloney murine leukemia virus and HIV[M31066].

Secretin induction. Methanol extract of the rhizome, administered to dogs intraduodenally at a dose of 0.5 gm/animal and intragastrically at a dose of 2.0 gm/animal, were active[M18099].

Smooth muscle relaxant activity. A preparation that included 1.875 gm each of *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, *Glycyrrhiza glabra* and 3.75 gm *Zingiber officinale* was active on the mouse ileum vs barium-induced contractions [M20428]. Water extract of the dried root, at a concentration of 0.1 mg/ml, was active on mouse ileum[N13376].

Sodium channel blocking effect. Decoction of the dried root, in a mixture with *Tricticum aestivum* and *Ziziphus jujuba*, at a

concentration of 4.0%, was active on the snail neuron[M18551].

Spermicidal effect. Saponin fraction of the aerial parts, at a concentration of 2.0%, was inactive on the human spermatozoa[K01553].

Spontaneous activity reduction. A preparation that included 1.875 gm each of *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia ternata*, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, and *Glycyrrhiza glabra* and 3.75 gm *Zingiber officinale*, at a dose of 0.5 gm/kg, was active on the mouse[M20428].

Superoxide dismutase inhibition. Water extract of the dried root, in the ration of mice at a concentration of 2.5% of the diet, was active[K11705].

Taenifuge activity. Ethanol (95%) extract of the root, at a concentration of 1.0 mg/ml, was active on *Taenia pisiforma*[A05480].

Teratogenic activity. Ethanol (40%) extract of the dried root, administered orally to pregnant rabbits at a dose of 1.6 ml/kg, was inactive[T01997].

Testosterone hydroxylation stimulation. The root, administered intragastrically to mice of both sexes at a dose of 6.2 gm/day, was active on liver microsomes[J14578].

Toxic effect. A case was reported of a 45 year-old man who was ingesting 100 to 200 gm of rhizome daily. The subject experienced necrosis of muscle fibers, highly contracted sacromeres with Z-line disorganization and a decreased level of myoadenylate deaminase[K11894]. Ethanol (40%) extract of the dried root, administered orally to rats of both sexes at a dose of 1.6 ml/kg daily for 13 weeks, was inactive. The dose had no effect on hemoglobin, red blood cells, packed cell volume, mean corpuscle volume, mean corpuscle hemoglobin concentration, total and differential white blood cells, serum GOT, blood glucose, BUN, bilirubin, total protein albumin, Na^+, K^+, Cl^-, or cholesterol. Urine samples were normal (microscopic, chemical, cell counts). Histology after sacrifice of the animals showed no pathology of the brain, pituitary, eye, salivary gland, cervical lymph node, thyroid, tongue, aorta, heart, thymus, lungs, sternal bone or marrow, esophagus, stomach, duodenum, jejunum, ileum, large intestine, liver, spleen, mesenteric lymph node, pancreas, kidneys, adrenals, bladder, gonads, prostate, seminal vesicle, uterus, skin, mammary gland, nerve or voluntary muscle. Weights of the following organs were normal: liver, kidneys, adrenals, heart, brain, prostate, and uterus[T01997]. A case was reported of woman 40 years of age with severe hypertension and hypokalaemic metabolic alkalosis due to prolonged licorice ingestion[J12350]. A 69 year-old female developed a case of pseudoaldosteronism after daily use of a mouth refresher containing licorice[J12934]. Infusion of the dried rhizome, administered intragastrically to dogs, was inactive[K27014]. The infusion, in combination with *Helichrysum arenarium*, *Tanacetum vulgare*, *Mentha piperita*, and *Urtica dioica*, administered intragastrically to rats and dogs, had no adverse effect on internal organs, rat embryos and fetuses and postnatal development. There were stabilizing effects on the liver of animals treated with CCl_4 and activated microsomal monooxygenases[K27014]. Licorice extract, at a dose of 25 to 200 gm/daily for 6 months to 5 years, consumed by 4 women aged 38 to 55 years, produced suppression of renin-angiotensin-aldosterone axis resulting in mineralocorticoid deficiency[M01056]. Water extract of the dried rhizome, taken orally by a 15 year-old male, developed a hypertension encephalopathy after ingesting 0.5 kg of licorice candy. He recovered completely in the course of 5 months[K25908]. Water extract of the dried root (48-58% glycyrrhizin), administered orally to rats of both sexes at a dose of 0.63 gm/kg daily for 90 days, had no toxic effect. A dose of 2.5 gm/kg decreased body-weight, blood cell count

and thymus weight. Atropic cortex and sporadic lymphofollicle formation were noted in the medulla of the thymus gland. All changes reverted to normal after discontinuation of the treatment. A dose of 200 mg/kg, adminsitered by gastric intubation to rats, produce no change in bodyweight, organ weight, blood cell count or histological changes in the liver and kidneys[M05081]. Water extract of the rhizome, taken orally by adults at variable dosage levels, was active. Five patients who used a laxative containing licorice suffered from toxicities which included hypertension, decreased potassium, plasma renin, and aldosterone levels[M31333]. Water extract of the root, taken orally by a woman 58 years of age at a dose of 1.8 kg/week, was active. The patient was admitted to hospital because of weakness in the limbs and tiredness[M01047].

Toxicity assessment. Ethanol (30%) extract of the root, administered orally to mice of both sexes, produced LD_{50} 32.0 ml/kg. The LD_{50} for 30% ethanol was 42 ml/kg[T01446]. Ethanol/water (1:1) extract of the dried root, administered intraperitoneally to mice, produced LD_{50} 681.0 mg/kg[T10126]. Water extract of the dried root (48-58% glycyrrhizin), administered intraperitoneally, orally and subcutaneously to mice and rats, produced LD_{50} 1.5 gm/kg, 16.0 gm/kg, and 4.2 gm/kg, respectively[N03792].

Tranquilizing effect. A preparation that included 1.875 gm each of *Coptis chinensis*, *Scutellaria baicalensis*, Liriope sp., *Pinellia ternata*, Lycium sp., Pachyma sp., *Paeonia rubra*, Akebia sp., *Rehmannia glutinosa, and Glycyrrhiza glabra* and 3.75 gm *Zingiber officinale*, at a dose of 0.5 gm/kg, was active on mice vs rotarod test[M20428].

Tryptophan pyrrolase stimulation. Hot water extract of the dried root, in a mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng*, administered intraperitoneally to rats at a dose of 200.0 mg/kg, suppressed decrease in hepatic tryptophan pyrrolase due to d-galactosamine-induced liver injury vs d-galactosamine-induced hepatotoxicity[T14824].

Turgal stimulant activity. Hot water extract of the dried root, in a mixture containing 7 gm *Bupleurum falcatum*, 5 gm *Pinella ternata*, 3 gm *Scutellaria baicalensis*, 4 gm *Zingiber officinale*, 3 gm *Ziziphus inermis*, 2 gm *Glycyrrhiza glabra*, and 3 gm *Panax ginseng*, administered intraperitoneally to rats at a dose of 200.0 mg/kg, decreased the volume of exudate[T14878].

Tyrosinase inhibition. Fat soluble fraction of the dried root was active, IC_{50} 3.1 mcg[K23645].

UDP glucuronyl transferase stimulation. Water extract of the dried root, in the ration of mice at a concentration of 25.0% of the diet, was inactive[K11705].

Ureteral stone removal. Water extract of the root, taken by adults orally in combination with other plants, was active[J09831].

Uterine relaxation effect. Ethanol (95%) extract of the root, at a concentration of 1.0 mg/ml, was effective on the pregnant and nonpregnant uterus of dogs[A05480] and mice[A00008]. The water extract, administered intraperitoneally to mice and rats at a dose of 50.0 mg/animal, was active[A05606]. Water extract of the dried root, in a mixture with *Pinellia ternata*, *Citrus aurantium*, *Pachyma hoelen*, and *Zingiber officinale*, at a concentration of 0.01 gm/ml, was active on a rat uterus vs ACh and barium-induced contractions[T11368]. Water extract of the root was active on a rat uterus[A00358].

Uterine stimulant effect. Ethanol (95%) extract of the root, at a concentration of 8.0 mg/ml, was inactive on the pregnant and nonpregnant uterus of dogs[A05480].

Vasodilator activity. A preparation that included 1.875 gm each of *Coptis chinensis*, *Scutellaria baicalensis*, *Liriope* species, *Pinellia*

ternata, *Lycium* species, *Pachyma* species, *Paeonia rubra*, *Akebia* species, *Rehmannia glutinosa*, and *Glycyrrhiza glabra* and 3.75 gm *Zingiber officinale*, at a concentration of 1.0%, was active on the rabbit blood vessel[M20428].

WBC stimulant. Decoction of the dried root, in a prescription containing *Glycyrrhiza glabra* root, *Panax ginseng* root, *Bupleurum falcatum* root, *Scutellaria baicalensis* root, *Zingiber officinale* rhizome, *Pinellia ternata* tuber, and *Ziziphus vulgaris* fruit, at a concentration of 20.0 mcg/ml, produced an average enhanced response of 40%. When enhancement of pokeweed mitogen-induced peripheral mononuclear cell proliferation was assayed, the response was enhanced an average of 34%. The extract was inactive when enhancement of phytohemagglutinin- and concanvallin A-induced peripheral mononuclear cell proliferation were assayed, and on leukocytes obtained from AIDS patients. The response increased 23% with enhancement of pokeweed mitogen-induced proliferation in leukocytes obtained from AIDS patients[K07123].

Weight gain increase. Hot water extract of the dried root, when taken orally by healthy subjects at a dose of 100 gm/day for 8 weeks, showed a mean increase of 1.6 kg. The weight gain was normalized 3 weeks after the end of the treatment[M21430].

Weight gain inhibition. Water extract of the dried root, in the ration of mice at a concentration of 8.0% of the diet, was effective[K11705].

Weight loss. Hot water extract of a mixture containing 8 gm *Bupleurum* species, 3 gm *Glycyrrhiza glabra*, 3 gm *Ziziphus jujuba*, 1 gm *Zingiber officinale*, 3 gm *Panax ginseng*, 8 gm *Pinellia ternata*, and 3 gm *Scutellaria baicalensis*, administered by gastric intubation to rats at a dose of 1.1 gm/kg, was effective[T09859].

Xanthine oxidase inhibition. Water extract of the dried root, at a concentration of 30.0 mcg/ml, was active[M28190].

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12 Hypericum perforatum

L.

Common Names

Balsana	Arabic Countries	Johaniskraut	Germany
Balsana	India	Johannesort	Sweden
Bassant	India	Johanniskraut	Europe
Blutkraut	Germany	Liebeskraut	Europe
Corazancillo	Spain	Pelatro	Italy
Corazoncillo	Argentina	Pelicao	Madeira
Dendhu	India	Perforata	Italy
Devil's scorge	Europe	Pinillo de Oro	Spain
Eisenblut	Europe	Qian Ceng lou	China
Flor De Sao Joao	Madeira	Saint John's wort	Greece
Fuga daemonum	Europe	Sanjuanera	Spain
Hartheu	Europe	Sint-Janskruid	Netherlands
Heofariqon	Arabic Countries	St. John's Worth	Canada
Herba de Millepertuis	France	St. John's Worth	Estonia
Herba de Saint Jean	France	St. John's Worth	Germany
Herrgottsblut	Germany	St. John's Wort	USA
Hexenkraut	Europe	St. John's Wort	USSR
Hierba De San Juan	Spain	Tenturotou	Turkey
Hipericao	Madeira	Teufelsflucht	Europe
Hiperico	Argentina	Toutsaine	France
Hipericon	Argentina	Witcher's herb	Europe
Hipericon	Spain	Zwieroboij	USSR
Iperico	Italy		

BOTANICAL DESCRIPTION

A herbaceous, rhizomatous perennial herb of the HYPERICACEAE family that grows to a height of up to 1 m with erect stems that are 2-edged and branching in the upper part. The leaves are pale green, opposite, sessile, oblong, ovate or linear, 8–24 mm long with black dots or oil glands that can be seen when holding the leaf to light. The flowers are bright yellow, about 25 mm in diameter, in terminal corymbose cymbes. The calyx and corolla are marked with black dots and lines. Sepals and petals are 5 in number, and the ovary is pear-shaped

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with 3 long styles. The capsule is 3-celled, ovoid, 8 mm long, with many small round blackish seeds. The plant has a characteristic balsamic odor and a bitter, resinous, somewhat astringent taste.

ORIGIN AND DISTRIBUTION

H. perforatum is native to Europe, Western Asia, North Africa, Madeira and the Azores. It now grows in parts of North America and Australia.

TRADITIONAL MEDICINAL USES

Arabic countries. The dried entire plant is used in the form of a vaginal pessary, in Unani medicine, as an emmenagogue[HP0219].

Argentina. Olive oil extract of the leaf is taken orally for menstrual cramps[HP0237].

England. Hot water extract of the dried leaf is used topically to promote hair growth, and for wounds and bruises. The extract is taken orally for venomous bites and intestinal worms[HP0215].

Europe. Hot water extract of the aerial part is taken orally as an emmenagogue, and as a diuretic. Externally, the aerial part is used for wound healing[HP0118]. Hot water extract of the entire plant is taken orally for menstrual complaints[HP0238]. Hot water extract of the leaf is taken orally to produce abortion[HP0210].

Germany. The fresh leaf and stem is eaten for nervous disorders and sleeplessness[HP0139]. Water extract of the leaf is taken orally as an antidepressant[HP0183].

Greece. Olive oil extract of the flowers is used to treat skin wounds and herpes zoster. The flower in olive oil is exposed to sun for a week. When the solution takes on an orange color, it is applied to the infected area[HP0186]. The aerial part is applied externally to aid wound healing[HP0109].

India. Hot water extract of the aerial part is taken orally as an anthelmintic and emmenagogue[HP0244]. Hot water extract of the dried aerial part is taken orally as an emmenagogue, anthelmintic and diuretic[HP0216]. Hot water extract of the dried entire plant is taken orally as an anthelmintic and emmenagogue[HP0240]. Hot water extract of the entire plant is taken orally as an emmenagogue[HP0106].

Italy. Acetic acid (2%) extract of the dried flower is taken orally as an antihematoma. The infusion is taken orally to treat articular aches[HP0231]. Olive oil extract of the flowering tops is used externally for Herpes simplex lesions, especially on the lips[HP0229]. Hot water extract of the dried flowering tops is used topically for inflammations[HP0203].

Madeira. Infusion of the entire plant is taken orally as a diuretic for gout, lithemia and kidney diseases[HP0192].

Soviet Union. Hot water extract of the aerial part is taken orally for treating goiter[HP0104]. Hot water extract of the leaf is taken orally for bacillary dysentery[HP0235].

Spain. Hot water extract of the dried aerial part is used externally for wound healing, and orally as a spasmolytic and for colds[HP0230]. Water extract of the flower and leaf is taken orally 2 to 3 times a day for scanty and difficult menstruation[HP0123].

Turkey. Decoction of the aerial part is taken orally for stomachache[HP0190]. Infusion of the dried aerial part is taken orally to treat stomachache. One glass of the infusion with other herbs and flower is taken twice a day[HP0184]. Hot water extract of the dried aerial part is taken orally for neurological disorders, convulsions, tetanus, ulcers[HP0193], common cold, gastrointestinal disorders, jaundice, hepatic disorders, biliary disorders, and the healing of wounds[HP0208]. Pounded fresh flower is applied directly on open wounds to promote healing[HP0184].

USA. Fluid extract of the inflorescence is taken orally for menorrhagia, hysteria, nervous affections, jaundice, worms, as a sedative, and diuretic. Externally, the fluid extract is used to treat hard tumors[HP0124]. Hot water extract of the aerial part is taken orally to promote menstruation and for painful menstruation[HP0197]. When administered to cows

Plate 7. ***Echinacea angustifolia*** **(*see* full discussion in Chapter 7).**

Plate 8. ***Ephedra sinica*** **(*see* full discussion in Chapter 8).**

Plate 9. ***Eucalyptus globulus*** **(*see* full discussion in Chapter 9).**

Plate 10. ***Ginkgo biloba*** **(*see* full discussion in Chapter 10).**

Plate 11. ***Glycyrrhiza glabra*** **(*see* full discussion in Chapter 11).**

Plate 12. ***Hypericum perforatum*** **(*see* full discussion in Chapter 12).**

Plate 1. ***Allium cepa*** **(*see* full discussion in Chapter 1).**

Plate 2. ***Althaea officinalis*** **(*see* full discussion in Chapter 2).**

Plate 3. ***Anacardium occidentale*** **(*see* full discussion in Chapter 3).**

Plate 4. ***Ananas comosus*** **(*see* full discussion in Chapter 4).**

Plate 5. ***Angelica sinensis*** **(*see* full discussion in Chapter 5).**

Plate 6. ***Azadirachta indica*** **(*see* full discussion in Chapter 6).**

Plate 13. ***Laurus nobilis*** **(*see* full discussion in Chapter 13).**

Plate 14. ***Lycopersicon esculentum*** **(*see* full discussion in Chapter 14).**

Plate 15. ***Matricaria chamomilla*** **(*see* full discussion in Chapter 15).**

Plate 16. ***Morinda citrifolia*** **(*see* full discussion in Chapter 16).**

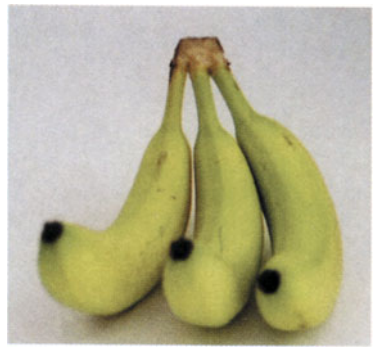

Plate 17. ***Musa sapientum*** **(*see* full discussion in Chapter 17).**

Plate 18. ***Myristica fragrans*** **(*see* full discussion in Chapter 18).**

Plate 19. ***Nelumbo nucifera*** **(*see* full discussion in Chapter 19).**

Plate 20. ***Pimpinella anisum*** **(*see* full discussion in Chapter 20).**

Plate 21. ***Ricinus communis*** **(*see* full discussion in Chapter 21).**

Plate 22. ***Tanacetum parthenium*** **(*see* full discussion in Chapter 22).**

Plate 23. ***Tribulus terrestris*** **(*see* full discussion in Chapter 23).**

Plate 24. ***Vitex agnus-castus*** **(*see* full discussion in Chapter 24).**

in the ration, the aerial part produced eruptions on the udder[HP0120]. Hot water extract of the dried flowering tops is taken orally as an astringent and has a peculiar soothing effect. The extract is used as an ointment for skin irritation and insect bites[HP0241].

Yugoslavia. Hot water extract of the dried aerial part is taken orally for diabetes. Hot water extract of the dried flower is taken orally for diabetes[HP0212].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Adhyperfolin: Fl, Fr[HP0136]
Alkanes (C28,C30): Aer[HP0132]
Alkanols (C24,C26,C28): Aer[HP0132]
Amentoflavone: Aer 0.0267%[HP0195]
Amyrin,beta, Aer[HP0222]
Apigenin: Aer[HP0152]
Apigenin,1(3)-11(8)-Bl: Fl[HP0179]
Apigenin,Bl: Aer[HP0152]
Apigenin,1(3)-ll(8)-Bl: Aer 72.5[HP0200]
Ascorbic acid: Lf[HP0116]
Biapigenin,1-3 ll-8: Aer 0.01%[HP0195]
Cadiforin,hydroperoxy: Aer 5.6[HP0137]
Caffeic acid: Pl[HP0214], Aer 0.1%[HP0234]
Carotene,beta: Aer 12.1 mg/%[HP0122]
Caryophyllene: EO[HP0133]
Catechin,(+): Pl[HP0221,HP0206]
Catechin,epi(-): Pl[HP0199]
Chlorogenic acid: Pl[HP0199]
Choline: Aer 0.1%[HP0107]
Cuprenene,alpha: Lf EO[HP0138]
Cyclopseudohypericin: Pl[HP0213,HP0180]
Cysteine: Pl[HP0218]
Decanal,n: EO[HP0133]
Decane,2-methyl: Aer[HP0134]
Essential oil: Aer 0.07-0.08%[HP0108]
Flavone: Aer[HP0165]
Gallic acid: Pl[HP0214]
Glutamine: Pl[HP0218]
Heptane,2-4-dione,5-methyl: Lf EO[HP0138]
Heptane,2-4-dione,6-methyl: Lf EO[HP0138]
Hexacosan-1-ol: Lf[HP0220]
Humulene: EO[HP0133]
Hypercinin,cyclo-pseudo: Aer[HP0163]
Hyperfolin: Lf, St[HP0139]
Hyperforin: Aer[HP0113,HP0162]
Hypericin: Fl 0.036-0.22%[HP0185], Lf 0.195%, EO 0.22%[HP0112]
Hypericin,proto-pseudo: Pl[HP0180], Fl 0.51%[HP0168]
Hypericin,proto: Pl[HP0180], Fl 0.182%[HP0168]
Hypericin,psuedo: Pl[HP0180], Fl 0.10-0.58%[HP0185,HP0168]
Hyperoside: Pl[HP0130], Aer 0.5-4.0%[HP0110,HP0242]
Imanin: Aer[HP0131]
Ishwarane: Lf EO[HP0138]
Kaempferol: Pl[HP0206]
Kielcorin: Rt[HP0198]
Leucine: Pl[HP0218]
Limonene: Aer EO[HP0134]
Linoleic acid: Flowering tops 13%[HP0173]
Lutein: Fl[HP0135]
Luteoxanthin: Fl[HP0135]
Lysine: Pl[HP0218]
Mangiferin: Aer[HP0163]
Melatonin: Fl 4.4, Lf 17.5[HP0172]
Myrcene: Aer[HP0134]
Myricetin: Pl[HP0206]
Myristic acid: Fl[HP0135]
Neoxanthin: Fl[HP0135]
Nicotinic acid: Lf 7.2[HP0103]
Nonane,n: Aer EO[HP0134]
Novoimanin: Aer 3-4%[HP0121]
Octacosan-1-ol: Lf[HP0220]
Octanal,n: EO[HP0133]
Octane,2-methyl: Aer EO[HP0134]
Ornithine: Pl[HP0218]
Palmitic acid: Flowering tops 30.7%[HP0173]
Perflavit: Aer[HP0115]
Phenol: Aer[HP0201]
Phloroglucinol: Aer[HP0201]
Pinene,alpha: Aer EO[HP0134]
Pinene,beta: Aer EO[HP0134]
Proline: Pl[HP0218]
Pyrano(4-3-B)-pyran-5-one,2(H)-5-(H) 7-iso-butyl-2-2-dimethyl: Lf EO[HP0138]
Pyrano(4-3-B)-pyran-5-one,2(H)-5-(H) 7-sec-butyl-2-2-dimethyl: Lf EO[HP0138]
Pyrocatechol: Aer[HP0201]
Pyrogallol: Aer[HP0201]
Quercetin: Pl[HP0114,HP0211]
Quercetin-3-0-glucuronide: Aer[HP0181]
Quercetin-3-0-xyloside: Aer[HP0181]
Quercetrin: Pl[HP0169]
Quercitin,iso: Pl[HP0206]
Quercitrin: Pl[HP0126]
Quercitrin,iso: Aer[HP0162]
Resorcinol: Aer[HP0201]
Rutin: Pl[HP0126], Aer 2.32%[HP0155]
Scopoletin: Pl[HP0218]

Sitosterol,beta: Aer[HP0132]
Stearic acid: Flowering tops[HP0173]
Tannin: Lf 12.4%, Fl 16.2%, St 3.8%[HP0125]
Taraxasterol: Aer[HP0222]
Tetracosan-l-ol: Lf[HP0220]
Threonine: Pl[HP0218]
Triacontan-l-ol: Lf[HP0220]
Trollichrome: Fl[HP0135]
Trollixanthin: Fl[HP0135]
Trollixanthin,cis: Fl[HP0135]
Umbelliferone: Pl[HP0218]
Undecan,n: Aer EO[HP0134]
Violaxanthin: Fl[HP0135]
Xanthone,1-3-6-7-tetrahydroxy: Lf[HP0183]
Xanthone,1-3-6-trihydroxy: Aer[HP0163]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

AIDS therapeutic effect. Sixty early ARC patients were administered St. Johns' Wort tablets (standardized at 0.14% hypericin) with or without AZT for 6 months. Twenty-five patients completed the 6 months of therapy (most of the patients were lost to follow up). No significant CD4+, CD8+ or P24 antigen levels were seen in any of the groups[HP0228].

Analgesic activity. Ethanol/water (1:1) extract of the entire plant, administered intragastrically to mice, was not effective vs hot plate and tail clip methods[HP0232]. Ethanol/water (1:1) extract of the dried aerial part, administered intraperitoneally to mice at a dose of 250.0 mg/kg, was effective vs tail flick response to radiant heat[HP0193]. Flavonoid fraction of the dried shoots, administered intraperitoneally to mice, was effective[HP0227].

Anesthetic activity. The essential oil was effective in treating earaches when administered as an ear drop[HP0118].

Antianginal activity. The leaf (20–60%), mixed with *Filipendula ulmaria* (40–80%) and 1.5% salicylic acid, has been patented as a treatment for angina pectoris and cardiac diseases[HP0243].

Antibacterial activity. Chloroform extract of the dried aerial part, at a concentration of 0.04 ml/disc, was active on *Staphylococcus aureus*, *Staphylococcus oxford*, and *Streptococcus mutans*, and inactive on *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, and *Streptococcus sanguis*. The water extract was active on *Staphylococcus oxford* and inactive on *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus mutans*, and *Streptococcus sanguis*. The methanol extract was active on *Escherichia coli*, *Proteus vulgaris*, *Streptococcus mutans*, *Streptococcus sanguis* and, in broth culture, was active on *Staphylococcus oxford*, MIC 0.62 mg/ml, and on *Staphylococcus aureus*, MIC 1.25 mg/ml. The petroleum ether extract, on agar plate at a concentration of 0.04 ml/disc, was active on *Pseudomonas aeruginosa* and, in broth culture, was active on *Staphylococcus aureus*, *Staphylococcus oxford*, *Streptococcus mutans*, *Streptococcus sanguis*, *Escherichia coli* and *Proteus vulgaris*; MIC 0.31, 0.31, 0.31, 0.62, 1.25, and 1.25, respectively[HP0205]. The chloroform extract, at a concentration of 1.0 gm/liter on agar plate, produced weak activity, and the methanol extract was inactive on *Klebsiella pneumonia*. The chloroform and methanol extracts were inactive on *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*[HP0230]. Ethanol (95%) extract of the dried entire plant, on agar plate at variable concentrations, was inactive on *Aerobacter aerogenes*, *Bacillus globifer* and erythromycin and tetracycline resistant strains, *Bacillus mycoides*, *Bacillus subtilis*, *Escherichia coli* and streptomycin resistant strain, *Proteus morganii*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Serratia marcescens*, and *Streptococcus aureus*[HP0217]. Methanol extract of the dried aerial part, on agar plate at a concentration of 20.0 microliters/disc, was active on *Escherichia coli*; equivocal on *Pseudomonas aeruginosa* and *Staphylococcus aureus* (methicillin-sensitive); inactive on *Enterobacter aerogenes*, *Klebsiella pneu-monia*, *Salmonella typhimurium* TA98 and *Serratia marcescens*; and produced weak

activity on *Bacillus subtilis*[HP0245]. Petroleum ether extract of the dried aerial part, on agar plate, was active on *Staphylococcus aureus*[HP0147]. The aerial part, on agar plate, was active on *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Streptococcus mutans*[HP0153].

Antidepressant activity. Ethanol/water (1:1) extract of the dried aerial part, administered intraperitoneally to mice at a dose of 250.0 mg/kg, decreased swimming time, rota-rod walking time and decreased exploratory activity[HP0193]. Exudate from the aerial part used in a clinical trial was superior to placebo in alleviating the symptoms of depression as quantified by the Hamilton scale[HP0196]. Hydro-alcoholic extract of the dried aerial part, taken orally by 105 patients with mild depression of short duration at a dose of 900.0 mg/day, was active in a double-blind study with either 300 mg of the extract or placebo 3 times a day for 4 weeks. The effectiveness was judged according to the Hamilton depression scale after 2 and 4 weeks. The values of the mean basic score in these periods fell from 15.8 to 9.6 and 7.2 in the active group, and in the placebo group from 15.8 to 12.3 and 11.3. The differences between active and placebo groups were statistically significant at $p < 0.05$ and $p < 0.01$ achieved after 2 and 4 weeks, respectively. In the active group 28 of the 42 patients (67%), and in the placebo group, 13 of the 47 patients (28%) responded to treatment. Notable side effects were not found[HP0161]. In a randomized, double-blind study, the effectiveness and tolerance of a standardized preparation of *Hypericum perforatum* was examined and compared to maprotiline in a group of 102 patients with depression, in accordance with ICD-10, F 32.1. The study was conducted in the offices of neurology and psychiatry specialists. The patients received, over a period of 4 weeks, either 300 mg *Hypericum perforatum* extract or 25 mg maprotiline pills 3 times daily. The effectiveness was determined using the Hamilton depression scale (HAMD), the depression scale according to Von Zerssen (D-S), and the clinical global impression scale (CGI). The total score of the HAMD scale dropped during the 4 weeks of therapy in both treatment groups by about 50%. The mean values of the D-S scale and the CGI scale showed similar results, and after 4 weeks of therapy, no significant differences in either treatment group were noticed[HP0164]. A meta-analysis of 23 comparisons or placebo-controlled randomized trials of 1757 patients with mild to moderate depressions demonstrated that a dose of 900.0 mg/day of hydro-alcoholic extract of the dried aerial part, when taken orally, was significantly superior to placebo ($p = 0.05$) and as effective as standard antidepressant drugs. The side effects were lower in the extract treated group[HP0164]. In a randomized double-blind, placebo-controlled study of 50 patients with mild to moderate depression, treatment with 900 mg/day of hydro-alcoholic extract of the dried aerial part for 4 weeks was significantly more effective than placebo for reducing depressive symptoms. Thirty-nine patients with depression with somatic symptoms were treated with the extract for 4 weeks at a dose of 300 mg 3 times daily. The result showed a significant improvement in the active treatment group at the 5% level as compared to placebo. Seventy percent of the patients treated with the extract were free of symptoms after 4 weeks. Typical symptoms of depression such as lack of activity, tiredness, fatigue and disturbed sleep were especially responsive. In no case were any undesirable side effects observed[HP0159]. The leaf, taken orally by adults at a dose of 900.0 mg/person, was active in a double-blind, placebo-controlled study of 105 patients[HP0191]. The aerial part, taken orally by human adults of both sexes at a dose of 1.8 gm/day, was active. In a multi-center

study of the extract in severely depressed patients (HAMD score >20), in a randomized, double-blind study involving 20 psychiatric hospitals and day care centers in Germany, 209 patients received 6 weeks treatment of the extract, 600 mg 3 times daily or imipramine, 50 mg 3 times daily. Results indicated that both preparations were effective, although there was a trend in favor of imipramine. A randomized 6 week trial comparing a dose of 900 mg daily of *Hypericum perforatum* extract with 75 mg daily of amitriptyline in 165 patients with mild-to-moderate depression showed that both the extract and amitryptyline reduced mean HAMD scores when compared with baseline values. Amitriptyline appeared to have a more beneficial effect than *Hypericum perforatum*, although the side effects profile of *Hypericum perforatum* extract was more favorable[HP0141]. The aerial part, taken orally by human adults of both sexes at a dose of 900.0 mg/day, was active. The effectiveness and acceptance of a 4-week treatment with *Hypericum perforatum* extract were investigated by 663 private practitioners. The results of the 3250 patients (76% women and 24% men), were recorded using data sheets. The age of the patients ranged from 20 to 90 years of age (mean 51 years). Forty-nine percent of the patients were mildly depressed, 46% intermediate and 3% severely depressed. In about 30% of the patients, the situation normalized or improved during the therapy. Undesired drug effects were reported in 79 (2.4%) patients and 48 (1.5%) discontinued the therapy. The most frequently noted side effects were gastrointestinal irritations (0.6%), allergic reactions (0.5%), tiredness (0.4%), and restlessness (0.3%)[HP0154]. Ethanol (95%) extract of the aerial part, taken orally by human adults of both sexes at a dose of 300.0 mg/day, was active[HP0175]. Hydro-alcoholic extract of the aerial part, taken orally at a dose of 900.0 mg/day, was active. Seventy-two patients of 11 physicians' practices were treated in a double-blind study for a period of 6 weeks either with *Hypericum perforatum* extract or with placebo. Inclusion criterion was a major depression in accordance with DSM-III-R. The changes were controlled using 4 psychometric scales (HAMD, D-S, BEB, GCI). The statistic evaluation revealed, after 4 weeks of therapy, in all 4 psychometric tests, a significant improvement in the active group as compared to the placebo group; after switching the placebo group to active treatment (5th and 6th week of therapy), significant improvements were found in the original placebo group. No serious side effects were observed[HP0171]. Methanol extract of the aerial part, taken orally by human adults in 16 clinical studies of St. John's wort for the treatment of mild to moderate depression from 1991–1997, was active[HP0175]. In a 6 week study comparing *Hypericum perforatum* (300 mg 3 times daily) with imipramine (25 mg 3 times daily), the Hamilton depression scale scores decreased from 20.2 to 8.8 in the *Hypericum perforatum* group, and 19.4 to 10.7 in the imipramine group. Fewer and milder side effects were noted in the *Hypericum perforatum* group. In a 4 week double-blind trial of 105 out-patients with mild depression of short duration, 67% of the patients taking *Hypericum perforatum* improved, compared to 28% of the placebo group. No side effects were noted. Meta-analysis of 23 randomized trials of 1757 patients with mild or moderate depression indicated that *Hypericum perforatum* was more effective than the placebo and as effective as the standard antidepressant drugs. Fewer side effects were observed in the *Hypericum perforatum* group (19.8%) as compared to the standard antidepressant (52.8%). In a 4 week study in which *Hypericum perforatum* extract was compared with maprotline (25 mg/3 times a day) in 102 depressed patients, no significant differences were observed in either group[HP0142]. The dried aerial part,

taken orally by adults, was active[HP0156,HP0158]. Ethanol (95%) extract of the dried aerial part, administered intragastrically to male gerbils at a dose of 2.0 mg/kg, was active vs clonidine-induced depression. A dose of 5.0 mg/kg, administered intragastrically to mice, was active; it enhanced the exploratory activity in a foreign environment and activity in the water wheel test[HP0160]. In a double-blind comparative study of 135 depressed patients in 20 centers with typical depressions with single episode, several episodes, depressive neurosis, and adjustment disorder with depressed mood in accordance with DSM-III-R, 300 mg of hydro-alcoholic extract of the dried aerial part or 25 mg impramine were administered orally 3 times daily for 6 weeks. The main assessment criteria were the Hamilton depression scale, the depression scale according to Von Zerssen and the Clinical Global Impressions. In both groups, a parallel reduction of the Hamilton score from 20.2 to 8.8 (extract, n = 67) or from 19.4 to 10.7 (imipramine, n = 68), and the transformed D-S point values from 39.6 to 27.2 and 39.0 to 29.2 (imipramine) were found. In the group dosed with the extract, fewer and milder side effects were found as compared to imipramine. Tincture of the dried leaf was taken orally at a dose of 30 drops 3 times a day for 4–6 weeks by 6 women with depressive symptoms. In all of the patients there was an increase in 3-methoxy-4-hydroxy-phenylglucol, which is an expression of antidepressive reaction. The patients showed a quantitative improvement in anxiety, dysphoric mood, loss of interest, hypersomnia, anorexia, morning depression, insomnia, obstipation, psychomotor retardation and feelings of worthlessness. The leaf (20–60%), mixed with *Filipendula ulmaria* (40–80%) and 1.5% salicylic acid, has been patented as a treatment for angina pectoris and cardiac diseases[HP0225]. Hydro-alcoholic extract of the dried flower and leaf, taken orally by adults of both sexes, was active[HP0246].

Antifungal activity. Ethanol (95%) extract of the dried aerial part, on agar plate at a concentration of 6–10 mg/ml, was active on several fungi[HP0216]. Ethanol (95%) extract of the dried entire plant, on agar plate at variable concentrations, was inactive on *Fusarium culmoun*, *Fusarium solani*, *Penicillum notatum* and *Scopulariopsis* species[HP0217]. Methanol extract of the dried aerial part, on agar plate at a concentration of 80.0 mg/disc, was inactive on *Aspergillus flavus*, *Aspergillus fumigatus*, *Fusarium tricintum*, *Trichoderma viride*, and *Trichophyton mentagrophytes*, and produced weak activity on *Microsporum cookei* and *Microsporum gypseum*[HP0189]. Ethanol/water (1:1) extract of the dried flowering tops, at a concentration of 833.0 mg of the dried plant material/ml on agar plate, was inactive on *Aspergillus niger*, *Botrytis cinerea*, *Penicillum digitata*, *Rhizopus nigricans*, and *Trichophyton mentagrophytes*[HP0247]. The fresh entire plant, on agar plate at a concentration of 1.0 gm/ml, was inactive on *Cytospora* species, *Fomes annosus*, and *Pestaalotia funerea*[HP0248].

Anti-inflammatory activity. Ethanol (80%) extract of the dried flowering tops, administered by gastric intubation to male rats at dose of 100.0 mg/kg, produced 14% inhibition of edema vs carrageenin-induced pedal edema[HP0203]. The essential oil, used externally by adults of both sexes, was active in alleviating bedsores in elderly patients[HP0249].

Antimycobacterial activity. Chloroform and methanol extracts of the dried aerial part, on agar plate at a concentration of >1.0 gm/liter, were inactive on *Mycobacterium phlei*[HP0230]. Ethanol (95%) extract of the fresh flowers (1 part of fresh plant material to 3 parts of solvent), on agar plate, produced strong activity, and the water extract produced weak activity on *Mycobacterium tuberculosis*[HP0236]. Ethanol (95%) extract of the dried entire plant, on agar plate at vari-

able concentrations, was inactive on *Mycobacterium phlei* and *Mycobacterium smegmatis*[HP0217]. Fresh leaf juice, on agar plate, was active on *Mycobacterium tuberculosis*, MIC 1:80[HP0105]. Methanol extract of the dried aerial part, on agar plate at a concentration of 20.0 microliters/disc, was active on *Mycobacterium phlei*[HP0182].

Antipsoriatic activity. The leaf (20–60%), mixed with *Filipendula ulmaria* (40–80%) and 1.5% salicylic acid, has been patented as a treatment for rheumatism, phlebitis and psoriasis[HP0243].

Antispasmodic activity. Ethanol (95%) extract of the dried aerial part, at a concentration of 200.0 mcg/ml, was active on guinea pig ileum vs histamine-induced contractions, and strong activity was produced vs barium-induced contractions. The water extract was inactive vs histamine-induced contractions, and produced weak activity vs barium-induced contractions[HP0223].

Antitumor activity. Water and ethanol (95%) extracts of the entire plant, administered intraperitoneally to mice, were inactive on Sarcoma 180 (solid) and CA-Ehrlich-ascites[HP0101].

Antiviral activity. Acetone, hot water and ethyl acetate extracts of the aerial part, in cell culture, were active on influenza virus[HP0177]. Ethanol/water (1:1) extract of the entire plant, in cell culture at a concentration of 0.05 mg/ml, was inactive on vaccinia virus[HP0232]. The hydro-alcoholic extract and decoction of the dried stem, at a concentration of 100.0 mcg/ml in cell culture on Vero cells, was inactive on Herpes simplex 1 and 2 virus and HIV when assayed in JM cells[HP0194]. Water extract of the aerial part, in cell culture at a concentration of 10.0%, was active on Herpes virus type 2, influenza virus A2 (Manheim 57) and vaccinia virus, and inactive on poliovirus II[HP0226]. Hot water extract of the dried flower and leaf, administered intraperitoneally to mice at a concentration of 5.0%, was active on encephalitis virus (unspecified)[HP0250].

Antiyeast activity. Chloroform and methanol extracts of the dried aerial part, on agar plate at a concentration of >1.0 gm/liter, were inactive on *Candida albicans*[HP0230]. Methanol extract of the dried aerial part, on agar plate at a concentration of 80.0 mg/disc, was inactive on *Candida albicans* and *Saccharomyces cerevisiae*[HP0189]. Ethanol/water (1:1) extract of the dried entire plant, on agar plate at variable concentrations, was inactive on *Kloekera brevis* and *Saccharomyces cerevisiae*[HP0217]. Ethanol/water (1:1) extract of the dried flowering top, at a concentration of 833.0 mg of plant material/ml, was inactive on *Saccharomyces pastorianus* and *Candida albicans*[HP0247].

Arachidonic acid release stimulation. Methanol extract of the aerial part was inactive vs cortical cells[HP0150].

Barbiturate sleeping time decrease. Ethanol/water (1:1) extract of the dried aerial part, administered intraperitoneally to mice at a dose of 500.0 mg/kg, was active vs CCl_4-induced hepatotoxicity[HP0208].

Benzodiazepine receptor binding. Methanol extract of the dried flower and the dried leaf inhibited 3H-flumazenil binding to benzodiazepine binding sites of the GABA receptors, IC_{50} 6.83 and 200.0 mcg/ml, respectively[HP0176].

Bile secretion increase. Ethanol/water (1:1) extract of the dried aerial part, administered intraperitoneally to mice at a dose of 500.0 mg/kg, was active[HP0208].

Cardiotonic activity. Hot water extract of the stem, administered intravenously to frogs, produced weak activity[HP0100].

Catechol-o-methyl transferase inhibition. Methanol extract of the dried aerial part, at a concentration of 1.0 mmol, was active. The petroleum ether extract was inactive[HP0170].

Chromosome aberrations. Ethanol (95%) extract of the dried leaf, administered intra-

gastrically to hamsters at a dose of 10.0 ml/kg, was inactive[HP0207].

CNS depressant activity. Ethanol/water (1:1) extract of the dried aerial part, administered intragastrically to mice at a concentration of 25.5 mg/kg, produced weak activity. The activity decreased with increased dosage using the actimeter test, results significant at P <0.005 level[HP0149].

Convulsant activity. The aerial part in both the fresh and dried form, in the ration of sheep, was active when the photosensitized animals contacted water[HP0128].

Coronary blood flow increase. Flavonoid fraction of the dried aerial part, at a concentration of 1.0 mcg/ml, was active on guinea pig heart[HP0144].

Creatine phosphokinase enhancement. The aerial part, administered intragastrically to cattle of both sexes at a dose of 3.0 gm/kg, was active[HP0143].

Cryoprotective activity. Methanol extract of the aerial part, in cell culture at a concentration of 40.0 mcg/ml, was inactive vs cortical cell line. The extract was also inactive vs GP120-induced cytotoxicity in cortical cells and NMDA-treated cortical cells[HP0150].

Cutaneous circulation effect. Hydro-alcoholic extract of the aerial part, taken orally by human adults of both sexes at a dose of 900.0 mg/day, was inactive in a clinical study of 25 individuals with mild depression. The effect of *Hypericum perforatum* on cutaneous circulation indicated no difference between the test group and the control group[HP0174].

Cytotoxic activity. Water and ethanol (95%) extracts of the entire plant, in cell culture, were inactive on CA-9KB, ED_{50} 100.0 mcg/ml and >0.1 mg/ml respectively[HP0101]. Water extract of the aerial part, in cell culture at a concentration of 10.0%, produced weak activity on Hela cells[HP0226].

Diuretic activity. Ethanol/water (1:1) extract of the entire plant, administered intragastrically to rats at a dose of 750.0 mg/kg, was inactive[HP0232]. Flavonoid fraction of the dried aerial part, at a dose of 4.0 gm/kg, produced weak activity[HP0242]. Water extract of the entire plant was active on dogs[HP0130].

DNA repair induction. Ethanol (95%) extract of the dried leaves was active on rat liver cells[HP0207].

Dopamine uptake inhibition. Carbon dioxide extract of the dried flower and leaf was active on synaptosomes[HP0251].

Emmolient effect. Olive oil extract of the flower was active as a burn treatment when applied topically[HP0140].

GABA inhibition. Carbon dioxide extract of the dried flower and leaf was active on synaptosomes[HP0251].

GABA receptor binding decrease. Hydro-alcoholic extract of the dried flower and leaf inhibited muscimol and CGP binding to GABA receptors, IC_{50} 3.24 and 3.31 mcg/ml, respectively[HP0252].

Genotoxicity activity. Ethanol (95%) extract of the dried leaf was inactive in in vitro studies in systems such as hypoxanthine guanidine phosphoribosyl transferase test, unscheduled DNA synthesis test and Syrian hamster embryo cell transformation test[HP0207].

Glutamate receptor binding decrease. Hydro-alcoholic extract of the dried flower and leaf inhibited CGP binding to the NMDA receptors[HP0252].

Glutamate uptake inhibition. Carbon dioxide extract of the dried flower and leaf was active on synaptosomes[HP0251].

Glutamate-oxaloacetate inhibition. Ethanol (95%) extract of the dried leaf, administered intragastrically to mice at variable dosage levels, was inactive vs fur spot test[HP0207].

Glycolysis inhibition. Water extract of the dried aerial part was active on the brain[HP0157].

Hair stimulant effect. Water extract of the entire plant, applied topically together with a mixture of other plants, was effective for alopecia[HP0111].

Hemagglutinin activity. Saline extract of the dried seeds, at a concentration of 10%, was inactive on the human RBC[HP0224].

Hepatotoxic activity. Thirty-one HIV positive patients were administered over-the-counter hypericin-containing herbal extracts orally. No statistically significant changes in CD4+ levels were seen in any patient group of the study. Five patients experienced elevated live function tests[HP0228].

Hypertensive activity. Hot water extract of the stem, administered intravenously to dogs at a dose of 1.0 ml/animal, was effective[HP0100].

Inotropic effect. Flavonoid fraction of the dried aerial part, at a concentration of 0.1 mcg/ml, had a positive effect on the heart[HP0144].

Insecticide activity. Water extract of the aerial part was inactive on *Blatella germanica* and *Oncopeltus fasciatus*[HP0239].

Interleukin-1-alpha release inhibition. Water extract of the entire plant was active on the human monocytes vs lipopolysaccharide stimulation[HP0253].

Interleukin-1-beta release inhibition. Hydro-alcoholic extract of the dried aerial part was equivocal on the human blood vs phytohemagglutinin or lipopolysaccharide-induced release[HP0166].

Interleukin-6 release. Hydro-alcoholic extract of the dried aerial part was active on the human blood vs phytohemagglutinin or lipopolysaccharide-induced release[HP0166].

Leukotriene B-4 production inhibition. Water extract of the entire plant was active on the human polymorphonuclear leukocytes vs calcium ionophore A23187-phorbol-12-myristate-13-acetate stimulation[HP0253].

Monoamine oxidase inhibition (Types A and B). Carbon dioxide extract of the dried flower, at a concentration of 50.0 mcg/ml, was inactive[HP0251]. Methanol and petroleum ether extracts of the dried aerial part, at a concentration of 1.0 mmol, produced weak activity[HP0170].

Muscarinic antagonist activity. Hydro-alcoholic extract of the aerial part, at a concentration of 1.0%, was active on mouse brain[HP0167].

Mutagenic activity. Chloroform, ethyl acetate and ethanol (95%) extracts of the dried aerial part, on agar plate at a concentration of 20.0 microliters/plate, were active on *Salmonella typhimurium* TA98[HP0188]. Ethanol (100%) extract of the dried flower, at variable concentrations on agar plate, was active on *Salmonella typhimurium* TA100 and TA98. Metabolic activation was required for activity[HP0202]. Ethanol (95%) extract and the essential oil of the dried leaf were active on *Salmonella typhimurium*[HP0204]. Tincture of the aerial part, on agar plate at a concentration of 160.0 microliters/disc, was active on *Salmonella typhimurium* TA100 and TA98. Metabolic activation had no effect on the results[HP0187].

Narcotic activity. Ethanol (95%) extract of the dried aerial part, administered intragastrically to mice, was active[HP0146].

Norepinephrine uptake inhibition. Carbon dioxide extract of the dried flower and leaf was active on synaptosomes[HP0251].

Phagocytosis stimulation. Ethanol (95%) extract and unsaponifiable fraction of the dried leaves, administered intraperitoneally to mice at a dose of 0.5 ml/animal, were inactive[HP0243].

Pharmacokinetic study. In a pharmacokinetic study, 1 mg of the hydro-alcoholic extract was administered as a single dose to human adults, and blood samples were taken. From 3.5 to 8 hours after dosing, the level of the extract increased from 0.45 ng/ml to 4.21 ng/ml. Maximum resorption time was 6 hours[HP0145].

Photosensitizer activity. Fluid extract of the entire plant, on agar plate, was inactive on *Candida albicans*[HP0117]. The aerial part,

in the ration of sheep, was active. Sheep with fully pigmented skin were insensitive to the action of the plant[HP0119].

Phototoxicity. The aerial part, in the ration of cattle of both sexes at a dose of 1.0 gm/kg, was inactive. The animals were dosed after exposure to sunlight. A dose of 3.0 gm/kg, administered intragastrically, was active. When the animals were dosed after exposure to sunlight, the temperature and respiration of the animals rose 3 to 4 hours later and the animals were restless and passed soft feces[HP0143].

Prophage induction. Ethanol (95%) extract of the dried entire plant, on agar plate at variable concentrations, was inactive. The assay system was intended to predict for antitumor activity[HP0217].

Reverse transcriptase inhibition. Acetone and ethanol (70%) extracts of the dried entire plant, at a concentration of 10.0 mcg/ml, were inactive. The ethanol (95%) extract was active[HP0254].

Serotonin receptor blocking effect. Hydro-alcoholic extract of the aerial part, at a concentration of 0.1%, produced weak activity on a mouse brain vs 5-HT-IAA receptor[HP0167].

Serotonin uptake inhibition. Carbon dioxide extract of the dried flower and leaf was active on synaptosomes[HP0251]. Hydro-alcoholic extract of the aerial part, at a concentration of 0.01%, was active on the mouse brain vs re-uptake of synaptosome preparations[HP0167].

Serotonin uptake stimulation. Methanol extract of the aerial part was active on the rat synaptosome, IC_{50} 6.2 mcg/ml[HP0150].

Sleep potentiation. Ethanol/water (1:1) extract of the dried aerial part, administered intragastrically to mice at a concentration of 13.25 mg/kg, produced weak activity vs influence on the sleep duration induced by pentobarbital. The activity was decreased with dosage, results significant at $p < 0.005$ level[HP0149]. The aerial part, administered intragastrically to male mice, extended narcotic-induced sleep[HP0142].

Smooth muscle relaxant activity. Ethyl acetate extract of the dried aerial part, at a concentration of 0.1 mg/ml, was active on pig arterial muscle vs histamine-induced contractions, and on the coronary artery vs prostaglandin F2 alpha-induced contractions[HP0148]. Water extract of the aerial part, at a concentration of 1:5, and tincture at a concentration of 1:20, were active on cat and mouse intestines[HP0127].

Smooth muscle stimulant activity. Hot water extract of the stem was active on the guinea pig ileum. The spasms were blocked by atropine[HP0100].

Spasmolytic activity. Ethanol/water (1:1) extract of the entire plant was inactive on a rat uterus[HP0232].

Toxic effect. The aerial part[HP0154] and its hydro-alcoholic extract [HP0171], when taken orally by adults of both sexes at a dose of 900.0 mg/day, were inactive. In an open study of 3250 patients treated with St. John's Wort, observed side effects were gastrointestinal (0.6%) and fatigue (0.4%)[HP0151]. The aerial part, administered orally to pigs, was active. Symptoms include temperature increase to about 105 degrees Fahrenheit, rapid pulse and respiration, diarrhea and dermatitis in the white animals after exposure to sunlight. Blistering and necrosis of the skin and subcutaneous tissue was observed. Intestinal and stomach inflammations were sometimes seen[HP0178].

Toxicity assessment. Ethanol/water (1:1) extract of the entire plant, administered intraperitoneally to mice, produced LD_{50} >1000 mg/kg[HP0232].

Tumor necrosing factor inhibition. Hydro-alcoholic extract of the dried aerial part was active on human blood vs phytohemagglutinin or lipopolysaccharide-induced release[HP0166].

Uterine relaxation effect. Hot water extract of the stem was active on a non-pregnant rat uterus[HP0100].

Uterine stimulant effect. Hot water extract of the stem, at a concentration of 50.0

ml/liter, was active on guinea pig uterus. A concentration of 100.0 ml/liter was active on human uterus. A dose of 2.0 ml/kg, administered intravenously to dogs, was inactive[HP0100]. Water extract of the leaf was active on nonpregnant rat uterus[HP0102].

Wound healing acceleration. Ethanol (60%) extract of the dried leaf, administered intragastrically to rats at a dose of 0.1 ml/animal, increased wound strength and rate of contraction and epithelization in excision wounds[HP0209]. Hot water extract of the aerial part, applied externally to rabbits[HP0233] and guinea pigs at a dose of 20.0%, was active vs experimentally-induced wounds[HP0129].

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13 Laurus nobilis

L.

Common Names

Alauro	Italy	Gar	Jordan
Alloro	Italy	Gekkeiju	Japan
Apollo's laurel	France	Hab-el-ghar	India
Asat sinda musa	Morocco	Habet L-gar	Morocco
Barge boo	Iran	Indian bay	USA
Bay laurel	Japan	Laurel comun	Argentina
Bay laurel	USA	Laurel noble	Argentina
Bay tree	Europe	Laurel real	Peru
Bay tree	Guyana	Laurel tree	Iran
Bay tree	Iran	Lauriello	Italy
Bay tree	Japan	Laurier D'apollon	France
Bay tree	USA	Laurier sauce	Tunisia
Bay tree	West Indies	Lauro	Italy
Bay	Brazil	Lorbeerfrucht	Italy
Bay	Japan	Rend	Tunisia
Derakhte barge boo	Iran	Sweet bay	Iran

BOTANICAL DESCRIPTION

A small evergreen tree of the LAURACEAE family. It is a hardy multi-branched tree with smooth bark that grows to about 10 m high. The leaves are glossy dark green lanceolate, alternate, acuminate at both ends and about 10 cm long. They are short-petioled and their margins are often sinuate and coriaceous and emit a sweet balsamic scent when bruised. The flowers are in axillary bushy umbels or short racemous panicles. They are dioecious, whitish-green, with 4 petals fused at the base. The male flower usually has 10–12 stamens, the female has 4 staminoids. The ovary is short-stemmed with 1 chamber with a hanging ovule, a short style and a triangular obtuse stigma. The fruit develops on the stem into deep-black 2 cm long ovate berries.

ORIGIN AND DISTRIBUTION

This family that is chiefly tropical originated in southern Asia. It is now distributed in the West Indies, South and Central America, the Mediterranean region and Africa.

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

TRADITIONAL MEDICINAL USES

Afghanistan. The leaf, mixed with anise and *Casuarina equisetifolia*, is inserted intravaginally to induce pregnancy[LN0171].

Argentina. Decoction of the dried leaf is taken orally to treat respiratory and urinary tract infections[LN0125]. Half to 1 gram of the fruit is taken orally to accelerate parturition. The leaf juice, 3–4 drops in water, is taken orally to promote menstruation[LN0105].

England. Hot water extract of the fruit is taken orally to induce menstruation[LN0104].

Europe. The fruit is taken orally during childbirth to speed up delivery[LN0104].

Greece. Hot water extract of the leaf is taken orally as a contraceptive[LN0175].

India. Hot water extract of the dried leaf is taken orally as an emmenagogue[LN0164]. The fruit is taken orally by women as an emmenagogue. Water extract of the leaf is taken orally as an emmenagogue[LN0102].

Iran. Decoction of the dried fruit is taken orally as an appetite stimulant and digestive aid. Infusion of the dried leaf is taken orally as a diaphoretic, antiflatulant, diuretic, for cramps, amenorrhea and catarrh, and in high doses as an emetic[LN0110].

Israel. Hot water extract of the dried leaf, together with *Ruta chalepensis*, is used in intravenous infusion for respiratory problems. Steam bath of the dried leaf, in combination with *Salvia fruticosa*, *Ruta chalepensis* and *Satureja thymbra*, is taken for colds and as a general tonic. The fruit essential oil is used externally on wounds and for rheumatic and neuralgic pains[LN0145].

Italy. Hot water extract of the dried leaf is used externally for inflammations[LN0141]. The infusion is taken orally to aid in digestion[LN0169]. Infusion of the leaf is taken orally as an antispasmodic for abdominal colic, and as a sedative and digestive. The essential oil is used as an emollient for hemorrhoids and for subcutaneous bleeding[LN0120]. The fruit is taken orally as anaperient[LN0120]. The dried fruit, macerated in alcohol, is mixed with olive oil and used externally as an antirheumatic[LN0169]. The ethanol/water (1:1) extract is taken orally to treat stomachache. A poultice prepared from the leaf is used to treat insect bites[LN0170].

Jordan. Decoction of the leaf is taken orally as an aperitive and antidiarrheal[LN0133].

Morocco. The leaf is taken orally for liver disorder and for dental hygiene[LN0134].

Peru. Hot water extract of the dried fruit is taken orally as a circulatory stimulant and used externally to soften tumors and ulcers[LN0167]. Hot water extract of the dried leaf is taken orally as a circulatory stimulant, and externally it is used to soften tumors and ulcers[LN0167].

Tunisia. The dried leaf is taken orally as a tranquilizer and used externally for rheumatism[LN0161].

USA. Hot water extract of the dried leaf is taken orally as a carminative, astringent and stomachic[LN0178].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Actinodaphnine: Wd, St Bk[LN0179]
Actinodaphnini, (+): Lf, St BK, Rt[LN0121]
Actinodaphnine, n-methyl, (+): Lf[LN0121]
Artemorin: Lf 140-231[LN0148,LN0155]
Astragalin: Lf[LN0150]
Boldine, (+): Lf[LN0121]
Borneol: Lf EO 0.47%[LN0113,LN0122]
Borneol acetate: Lf EO[LN0149]
Cadinene, delta: Lf EO[LN0149]
Caffeic acid: Lf, Fr[LN0157]
Camphene: Lf EO 0.7%[LN0174]
Camphor: Lf EO[LN0113]
Car-3-ene: Lf EO[LN0181,LN0149]
Carvacrol: Lf EO[LN0113]
Caryophyllene, alpha: Fr EO[LN0176]
Caryophyllene, beta: Lf EO 200[LN0113]
Catechin, (+): Lf[LN0137]
Catechin, epi, (-): Lf[LN0137]
Catechin, gallo, epi, (-): Lf[LN0137]
Cineol,1-8: Lf EO 21.14%-62.0%[LN0113,LN0174]
Cinnamic acid: Fr EO 9.0%[LN0176]
Cinnamic acid methyl ester: Fr EO 17.2%[LN0176]

Citral: Fr EO[LN0176]
Costunolide: Lf 0.119%[LN0155], Rt 0.31%[LN0118], Fr 0.256%[LN0106]
Costuslactone, dehydro: Fr 1.4%[LN0106]
Coumaric acid, para: Fr 20, Lf 192[LN0157]
Cryptodorine, (+): Lf[LN0121]
Cymene, para: Lf EO 19.83%[LN0116]
Decane, N: Lf EO[LN0149]
Docosan-1-ol tetradecanoate: Fr[LN0107]
Domesticine, iso, (+): Lf[LN0121]
Domesticine, iso, nor, (+): Lf[LN0121]
Elemene, beta: Lf EO[LN0149]
Eremanthin: Fr 1.4%[LN0106]
Essential oil (Laurus nobilis): Fr 3.9-4.1%[LN0176], Lf 2.5%[LN0174]
Estragole: Lf EO[LN0149]
Eudesmol, beta: Lf EO[LN0149]
Eugenol: Lf EO 0.36-1.02%[LN0181]
Eugenol acetate: Lf EO 0.5%[LN0174]
Eugenol methyl ether: Lf EO 0.5-7.7%[LN0174,LN0149]
Eugenol, acetyl: Lf EO[LN0139]
Gallocatechin, (+): Lf[LN0137]
Geraniol: Lf EO 1.3%[LN0174]
Geraniol acetate: Lf EO[LN0149]
Germacra-trans-1(10)-trans-5-diene-4(R)-11(epsilon)-diol,12-acetoxy,(7S): Fr 286[LN0106]
Guaiene, alpha: Lf EO[LN0149]
Guaijaverin: Lf[LN0150]
Hex-cis-3-en-1-ol-O-xyloside: Lf 16[LN0108]
Humulene: Lf EO[LN0149]
Juglanin: Lf[LN0150]
Kaempferol-3-0-alpha-L-(2,4-DL-trans-para-coumaroyl)-rhamnoside: Lf 5.6[LN0109]
Kaempferol-3-O-alpha-L-(2,4-cis-para-coumaroyl)-rhamnoside: Lf 20.6[LN0109]
Kaempferol,3-O-alpha-L(2-trans-para-coumaroyl)-rhamnoside: Lf 3.3[LN0109]
Kaempferol-3-O-alpha-L-(3,4-DL-trans-para-coumaroyl)-rhamnoside: Lf 20[LN0109]
Kaempferol-3-O-alpha-L-galactoside: Lf[LN0150]
Kaempferol-3-O-alpha-L-rhamnoside: Lf[LN0150]
Kaempferol-3-O-beta-D-rutinoside: Lf[LN0150]
Lariciresinol, iso, 5-methoxy, seco, 9-O-beta-D-xylopyranoside, (+): Lf 8[LN0108]
Lariciresinol, iso, seco, 9-O-beta-D-xylopyranoside, (+): Lf 15[LN0108]
Launobine: Pl[LN0154]
Launobine, (+): St Bk, Rt, Lf[LN0121]
Laurenobiolide: Lf[LN0155], Rt 0.06-0.2%[LN0118]
Laurenobiolide, deacetyl: Lf 50[LN0118]
Laurenoniolide: Rt[LN0173]
Limonene: Lf EO[LN0149]
Limonene, (+): Lf EO 2.9%[LN0174]
Linalool: Lf EO 0.4-18-4%[LN0174,LN0181]
Linalool acetate: Lf EO[LN0149]
Linalool, (+): Lf EO[LN0139]
Linalool, (-): Lf[LN0151]
Mannitol: Rt 0.64%[LN0155]
Myrcene: Lf EO 4.68%[LN0116]
Myrcene, beta: Lf EO[LN0113]
Nandigerine, (+): Lf[LN0121]
Neolitsine, (+): Lf[LN0121]
Nonane, N: Lf EO[LN0149]
Octacosan-1-ol, 10-hydroxy, tetradecanoate: Fr[LN0107]
Octulose, 3, D-gluco-L-Glycero, phellandrene, alpha: Fr EO 10.07%[LN0123], Lf[LN0151]
Pinene, alpha: Lf EO 0.13-9.30%[LN0113,LN0123]
Pinene, alpha, (-): Fr EO[LN0176]
Pinene, beta: Lf EO 0.16-5.40%[LN0113,LN0149]
Pinene, beta, (-): Fr EO[LN0176]
Pinocarveol, trans: Lf EO[LN0149]
Piperidine: Lf[LN0151]
Procyanidin B-2: Lf[LN0137]
Procyanidin B-4: Lf[LN0137]
Procyanidin B-5: Lf[LN0137]
Procyanidin B-7: Lf[LN0137]
Quercitrin-3-O-alpha-L-galactoside: Lf[LN0150]
Quercitrin: Lf[LN0150]
Quercitrin, iso: Lf[LN0150]
Reticuline, (+): St Bk, Lf[LN0121]
Reynosin: Lf 66-89[LN0148,LN0155]
Rutin: Lf[LN0150]
Sabinene: Lf EO 3.1-8.3%[LN0149,LN0181]
Santamarin: Lf 73.3[LN0148]
Santamarine: Lf 44[LN0155]
Schizandraside: Lf 24[LN0108]
Spathulenol: Lf[LN0149]
Terpinen-4-ol: Lf EO 0.78-2.2%[LN0113,LN0149]
Terpinene, alpha: Lf EO[LN0181]
Terpinene, gamma: Lf EO 0.17%[LN0113]
Terpineol: Fr EO 10.9%[LN0176]
Terpineol, 4: Lf EO[LN0116]
Terpineol, alpha: Fr EO 5.85%[LN0123], Lf EO 0.4%[LN0174]
Terpineol, alpha, (-): Lf EO[LN0100]

Terpineol, alpha, acetate: Lf EO 2.30-7.14%[LN0149,LN0116]
Terpinolene, alpha: Lf EO[LN0149]
Terpinyl acetate: EO[LN0140]
Thuj-2-en-4-ol-cis: Lf[LN0136]
Thujene, alpha: Lf EO[LN0149]
Thymol: Lf EO[LN0113]
Trepinen-4-ol: Lf EO[LN0139]
Triacontan-9-one, 11-hydroxy: Fr[LN0107]
Tridecane, N: Lf EO[LN0149]
Tulipinolide: Rt[LN0155]
Undecane, N: Lf EO[LN0149]
Verlotorin: Lf 123[LN0148]
Zaluzanin D: Fr 0.32%[LN0106]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Antiamoebic activity. The essential oil, in broth culture at a concentration of 2.0 microliters/ml, was active on *Entamoeba histolytica*[LN0127].

Antibacterial activity. Decoction of the dried leaf, on agar plate at a concentration of 1.0 mg/ml, was inactive on *Salmonella typhi*[LN0112]. The hot water extract, at a concentration of 62.5 mg/ml, was inactive on *Staphylococcus aureus*[LN0122]. The essential oil, on agar plate at a concentration of 15.0 microliters/disc, produced weak activity on *Staphylococcus aureus*. A concentration of 25.0 microliters/disc was active on *Escherichia coli*, and inactive on *Pseudomonas aeruginosa*[LN0165]. The fresh essential oil, on agar plate, was active on *Pseudomonas aeruginosa* and *Staphylococcus aureus* and inactive on *Bacillus cereus* and *Escherichia coli*[LN0159]. The leaf essential oil, on agar plate, was active on *Bacillus cereus*, *Escherichia coli* and *Staphylococcus aureus*, and inactive on *Pseudomonas aeruginosa*[LN0166]. The leaf essential oil, in broth culture, was active on *Sarcina lutea*, MIC 0.250 mg/ml; *Bacillus subtilis* and *Staphylococcus aureus*, MIC 0.333 mg/ml and *Escherichia coli*, MIC 0.500 mg/ml. It was inactive on *Bordetella bronchiseptica*, MIC > 1000 mg/ml[LN0147]. The powdered leaf, in broth culture at a concentration of 4.7%, produced weak activity on *Yersinia enterolytica*[LN0135].

Antiedema activity. Methanol extract of the dried leaf, applied externally to mice at a dose of 2.0 mg/ear, was active vs 12-0-tetradecanoyl phorbol-13-acetate (TPA)-induced ear inflammation. Inhibition ratio was 49[LN0119].

Antifungal activity. Hot water extract of the dried leaf, on agar plate at a concentration of 62.5 mg/ml, was inactive on *Aspergillus niger*[LN0122]. The essential oil, on agar plate, was inactive on *Penicillium cyclopium*, *Trichoderma viride* and *Aspergillus aegyptiacus*[LN0159]. The leaf essential oil, in broth culture, was active on *Aspergillus niger*, MIC 0.25 mg/ml[LN0147]. The leaf essential oil, on agar plate at a dose of 100.0 microliters, was active on *Sclerotinia sclerotiorum*, and produced weak activity on *Fusarium moniliforme*, *Phytophthora capsici* and *Rhizoctonia solani*[LN0115]. A concentration of 1.0 ml/plate was inactive on *Fusarium moniliforme*, *Phytophthora capsici*, *Rhizoctonia solani* and *Sclerotinia sclerotiorum*[LN0113]. A concentration of 10.0%/disc was inactive on *Geotrichum candidum*[LN0160]. The leaf essential oil, on agar plate, was active on *Aspergillus aegyptiacus* and *Trichoderma viride*[LN0166]. The leaf, on agar plate at a concentration of 2.0%, was inactive on *Aspergillus flavus*, *Aspergillus niger*, *Geotrichum candidum* and *Penicillium roquefortii*[LN0168].

Antihyperglycemic activity. Water extract of the dried leaf, administered intragastrically to rabbits at doses of 6.0, 8.0 and 10.0 gm/kg, was inactive vs alloxan-induced hyperglycemia[LN0129].

Antihypertensive activity. Ethanol (95%) extract of the dried entire plant, in a mixture containing *Cucumis melo*, *Carum carvi*, *Pimpinella anisum*, *Zea mays*, *Foeniculum vulgare*, *Tribulus terrestris* and *Prunus avium*, was active[LN0163].

Anti-inflammatory activity. Ethanol (80%) extract of the dried leaf, administered by gastric intubation to rats at a dose of 100.0 mg/kg, produced 19% inhibition of edema

vs carrageenin-induced pedal edema[LN0141]. Ethyl acetate and hexane extracts of the leaf, applied externally on mice at a dose of 20.0 microliters/animal, were active vs tetradecanoyl phorbol acetate phospholipids synthesis and 12-0-tetradecanoyl phorbol-13-acetate (TPA)-induced ear inflammation. The methanol extract was equivocal[LN0114].

Antimycobacterial activity. The leaf essential oil, on agar plate, was active on *Mycobacterium intracellulare*[LN0116]. The leaf juice, on agar plate, was active on *Mycobacterium tuberculosis*, MIC 1:160[LN0101].

Antioxidant activity. Petroleum ether extract of the leaf, at a concentration of 0.1%, produced weak activity. The petroleum ether insoluble fraction was insoluble[LN0153]. The essential oil was active. Antioxidant activity was measured by peroxide values[LN0111].

Antipyretic activity. Hot water extract of the dried leaf, taken orally by adults at a dose of 1.0 gm/person, was active[LN0103].

Antispasmodic activity. Ethanol (95%) extract of the dried entire plant, in a mixture containing *Cucumis melo*, *Carum carvi*, *pimpinella anisum*, *Zea mays*, *Foeniculum vulgare*, *Tribulus terrestris*, and *Prunus avium*, was active[LN0163].

Antiviral activity. Water extract of the dried fruit, in cell culture at a concentration of 10.0%, was active on Herpes virus type 2 and vaccinia virus, and inactive on influenza virus and poliovirus II[LN0162]. Water extract of the dried leaf, in cell culture at a concentration of 10.0%, was active on Herpes virus type 2 and vaccinia virus and inactive on influenza virus A2 (Manheim 57) and poliovirus II[LN0162].

Antiyeast activity. The essential oil, on agar plate at a concentration of 25.0 microliters/disc, was active on *Candida albicans*[LN0165]. The leaf essential oil, in broth culture, was active on *Candida parakrusei*, MIC 0.333 mg/ml and *Candida albicans*, MIC 0.500 mg/ml[LN0147]. The leaf essential oil, on agar plate at a concentration of 10.0%/disc, was active on *Torulopsis glabrata*, and inactive on *Brettanomyces anomalus*, *Candida lipolytica*, *Debaryomyces hansenii*, *Hansenula anomala*, *Klocdkera apiculata*, *Kluyveromyces fragilis*, *Lodderomyces elongisporus*, *Metschnikowia pulcherrima*, *Pichia membranaefaciens*, *Rhodotorula rubra* and *Saccharomyces cerevisiae*[LN0160]. The leaf essential oil, on agar plate, was active on *Candida albicans* and *Cryptococcus neoformans*[LN0116].

Barbiturate potentiation. Ether extract of the dried leaf, administered intraperitoneally to mice at a dose of 200.0 mg/kg, was inactive[LN0142].

Barbiturate sleeping time decrease. Ether extract of the dried leaf, administered intragastrically to mice at a dose of 200.0 mg/kg for 7 days, was inactive[LN0142].

Bradycardia activity. The dried leaf essential oil was active on the hearts of frogs and rabbits[LN0138].

Cytotoxic activity. Methanol extract of the dried leaf, in cell culture at a concentration of 100.0 mg/kg, was equivocal on Chinese-Hamster-V79 cells[LN0124]. Water extract of the dried leaf, in cell culture at a concentration of 10.0%, produced weak activity on Hela cells[LN0162]. Water extract of the dried fruit, in cell culture at a concentration of 10.0%, was inactive on Hela cells[LN0162].

Dermatitis producing effect. The dried leaf essential oil, applied externally at variable dosage levels, was active on human adults[LN0138].

Embryotoxic activity. Water extract of the dried leaf was active on *Biophalaria glabrata*, LD_{50} 124.4 ppm and LD_{90} 198.9 ppm[LN0146]. Water extract of the dried flower was active on *Biomphalaria glabrata*, LD_{50} 34.3 ppm and LD_{90} 50.1 ppm[LN0146].

GRAS status. The fruit essential oil was approved as a flavoring agent by the United States of America Food and Drug Administration in 1976 (Sect 582.20)[LN0117].

Hypoglycemic activity. Water extract of the dried leaf, administered intragastrically

to rabbits at doses of 6.0, 8.0 and 10.0 gm/kg, was inactive[LN0129].

Kidney dissolution effect. Ethanol (95%) extract of the dried entire plant, taken orally by adults, was effective. A mixture of *Cucumis melo, Carum carvi, Pimpinella anisum, Foeniculum vulgare, Prunus avium,* and *Tribulus terrestris* was taken by 300 patients with kidney or ureteral stones. Sixty-seven percent of the patients passed stones, 18% transferred and there was a decrease in the volume of stone in 11% of the patients. Ninety-eight percent of the patients reported relief from colic[LN0163].

Molluscicidal activity. Water extract of the dried flower was active on *Biomphalaria glabrata*, LD_{50} 242.0 ppm and LD_{90} 340.0 ppm[LN0146]. Water extract of the dried leaf was inactive on *Biophalaria glabrata*, LD_{50} 1219 ppm and LD_{90} 1900 ppm[LN0146].

Mutagenic activity. Chloroform/methanol (2:1) extract of the leaf, on agar plate at a concentration of 100.0 mg/plate, was inactive on *Salmonella typhimurium* TA100 and TA98. The effect was the same with or without metabolic activation. The water extract was inactive on Pig-Kidney-LLC-PK-1 cells and Trophoblastic-Placenta cells. The effect was the same with or without metabolic activation[LN0156]. Hot water and methanol extracts of the leaf, on agar plate at a concentration of 50.0 mg/disc, were inactive on *Salmonella typhimurium* TA98 and TA100. Histidine was removed from the extract prior to testing. The effect was the same with or without metabolic activation[LN0158].

Nematocidal activity. Water and methanol extracts of the dried leaf, in cell culture at a concentration of 10.0 mg/ml, were active on *Toxacara canis*[LN0132].

Photoxicity effect. The dried leaf essential oil, applied externally to mice and pigs, was inactive[LN0138].

Sensitization. The dried leaf essential oil, applied by patch test to adults at a concentration of 10.0%, was inactive[LN0138].

Toxicity assessment. Ethanol (95%) extract of the dried entire plant, in a mixture with *Cucumis melo, Carum carvi, Pimpinella anisum, Foeniculum vulgare, Prunus avium,* and *Tribulus terrestris*, was administered intraperitoneally to mice; LD_{50} was 7.0 ml/kg[LN0163]. The leaf essential oil, administered by gastric intubation to rats, produced LD_{50} 3.95 gm/kg. Intradermal administration to rabbits produced LD_{50} >5.0 gm/kg[LN0138].

Tumor promotion inhibition. Ethyl acetate extract of the leaf, in cell culture at a concentration of 50.0 mcg/ml, was equivocal on C3H/10Ti/2 cells vs tetradecanoyl phorbol acetate-induced acetate phospholipid synthesis. The hexane and methanol extracts were inactive[LN0114].

Tyrosinase inhibition. Ethanol/water (1:1) extract of the dried leaf, at a concentration of 0.5 mg/ml, was inactive[LN0126].

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14 Lycopersicon esculentum

Mill.

Common Names

Domates	Turkey	Tomate	Puerto Rico
Dumadu	Nicaragua	Tomatera	Spain
Gojeh farangee	Iran	Tomatis	Nicaragua
Jitomate	Mexico	Tomato	Greece
Ma khue thet	Thailand	Tomato	Canada
Nyanya	Tanzania	Tomato	Czechoslovakia
Palkcha	Mexico	Tomato	England
Pomme D'amour	Rodrigues Islands	Tomato	Guyana
Pomodoro	Italy	Tomato	India
Pummarola	Italy	Tomato	Iran
Takkali	India	Tomato	Japan
Tamatar	Fiji	Tomato	Tanzania
Tamatar	India	Tomato	Thailand
Tamatem	Tunisia	Tomato	USA
Tamatum	Oman	Tomato	Wales
Tomat	Haiti	Tomato	West Indies
Tomate	France	Vel vangi	India
Tomate	Guatemala	Vilayithi baingan	India
Tomate	Nicaragua	Vilayithi vengan	India
Tomate	Peru		

BOTANICAL DESCRIPTION

A spreading, pubescent herb of the SOLANACEAE family with a strong characteristic odor and grayish green, curled and unevenly pinnate leaves. The fruits are villose when young, and glabrous and shining when mature. Seeds are flat, kidney-shaped and hairy. The shape and size of the fruits and the thickness of the pericarp vary in the numerous types under cultivation.

ORIGIN AND DISTRIBUTION

The tomato plant is indigenous to the western regions of tropical South America. It is now cultivated throughout the world for its edible fruits.

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

TRADITIONAL MEDICINAL USES

Fiji. The fresh fruit juice is administered orally to induce vomiting in children in cases of poisoning, and to arrest excessive bleeding from wounds[LE0207].

Greece. The fresh fruit is used externally to treat furuncles[LE0155].

Guatemala. Hot water extract of the dried fruit is used externally for wounds, abscesses, furuncles, scrofula, ulcers, bruises, and sores[LE0217]. The leaf is used externally to treat burns[LE0165].

Haiti. The dried leaf and the fresh fruit are taken orally for buccal thrush. The decoction is taken orally for vomiting[LE0211].

Iran. The fresh fruit is taken orally for gout and detoxification, uremia, to remove urinary and bile solid deposits, as a laxative, to reduce intestinal inflammations, and for its anabolic activity, to reduce swelling of the joints and topically for acne[LE0112]. The fresh leaf is used as an insecticide. Five kg of fresh leaves are macerated in 5 liters of vinegar for 2 days and then mixed with 100 liters of boiling water for 15 minutes. This is then left at room temperature for 2 days, stirring occasionally[LE0112].

Italy. The fresh fruit is used externally to cure scorpion and other insect bites. The juice is taken orally as a cholagogue and the entire plant is used externally as an antivaricose[LE0168]. The fruit is used externally as a caustic[LE0139].

Ivory Coast. The fresh leaf is used externally as a hemostatic[LE0216].

Mexico. The fresh fruit is used externally as a febrifuge. The fruit is also placed on the leaf of *Ricinus communis* and used as a poultice on the abdomen[LE0202].

Oman. The leaf is used intranasally for nosebleeds[LE0137].

Peru. Hot water extract of the dried fruit is taken orally for tonsilitis and rectally for hemorrhoids[LE0215].

Philippines. The fresh fruit is used to treat edema during pregnancy. A poultice made of the fruit is applied to the abdomen[LE0205].

Rodrigues Islands. Decoction of the fresh fruit is taken orally by human adults to stop vomiting[LE0167].

Tunisia. Extract of the dried leaf is taken orally as a hypotensive and to treat kidney stones[LE0203].

Turkey. The fruit is used externally for scorpion sting[LE0166].

USA. The fresh fruit is taken orally to aid digestion, for kidney and liver troubles, and as a cathartic[LE0223].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Abscisic acid: Lf[LE0179]
Abscisic acid-1′-4′-trans-diol: Fr[LE0177]
Abscisic acid-1′-O-beta-d-glucopyranoside: St[LE0195]
Acetic acid: Fr[LE0104]
Aconitic acid, trans: Fr[LE0104]
Amyrin, beta: Sd[LE0169]
Antheraxanthin: Rt[LE0148]
Arabinitol,2-carboxy: Lf 115 nmol/gm[LE0159]
Ascorbic acid: Fr[LE0107,LE0118]
Benzaldehyde: Fr[LE0131]
Benzaldehyde, 4-hydroxy: Fr[LE0176]
Benzyl alcohol: Fr[LE0131]
Blumenol A 9-O-beta-d-glucopyranoside tetraacetate: Lf[LE0121]
Blumenol C O-beta-d-glucopyranoside tetraacetate: Lf[LE0121]
Butan-1-ol,2-methyl: Fr[LE0131]
Caffeic acid: Fr Pu[LE0113]
Car-2-ene: Lf[LE0133]
Carotene, beta: Fr 4.9[LE0134], Rt[LE0148]
Carotene, gamma: Fr 1.4[LE0134]
Carotene, pseudo beta cis-5: Fr[LE0175]
Carotene, pseudo epsilon cis-5: Fr[LE0175]
Caryophyllene, beta: EO 26.24%[LE0143]
Chlorogenic acid: Fr, Lf, Fl[LE0124]
Cholesta-7-24-dien-3-beta-ol, 4-alpha-24-dimethyl: Sd[LE0171]
Chlesta-8-24-dien-3-beta-ol, 4-alpha-14-alpha-24-trimethyl: Sd[LE0171]
Chromium: Lf [LE0186]
Citric acid: Fr[LE0104]
Citronellol: EO 0.16%[LE0143]
Citronellol: Fr[LE0131]
Citrostadienol: Sd[LE0171]
Coumaric acid, para: Pl[LE0176]
Coumarin: Fl, Fr[LE0124]

Cycloartanol: Sd[LE0169]
Cycloartanol, 24-methylene: Sd[LE0169]
Cycloartenol, 31-nor: Sd[LE0171]
Cycloeucalenol: Sd[LE0171]
Cyclohex-2-en-1-one,3-5-5-trimethyl-4-(3-hydroxy butylidene) cis-6, O-beta-D-glucopyranoside-tetracetate: Lf [LE0121]
Cyclohex-2-en-1-one,3-5-5-trimethyl-4-(3-hydroxy butylidene) trans-6, O-beta-D-glucopyranoside-tetracetate: Lf [LE0121]
Cyclohexanol: Fr EO[LE0172]
Cymene, para: EO .43%[LE0143]
Damascenone: Fr EO[LE0180]
Damascone, beta 3-hydroxy: Fr[LE0141,LE0131]
Dodecan-2-one: EO[LE0143]
Elemene, beta: EO 0.10%[LE0143]
Elemene, delta: EO 0.57%[LE0143]
Ethanol: Fr EO[LE0172]
Ethylene: Fr[LE0187]
Eugenol: Fr EO[LE0172]
Formic acid: Fr[LE0104]
Gentisic acid: Lf [LE0103]
Geranial: EO 0.10%[LE0143]
Geraniol: Fr[LE0131], EO 0.21%[LE0143]
Gibberellin A-1: Lf [LE0122], Sd, Pc[LE0219]
Gibberellin A-15: Sd[LE0219]
Gibberellin A-17: Sd[LE0219]
Gibberellin A-19: Sd[LE0219], Lf [LE0122]
Gibberellin A-24: Sd[LE0219]
Gibberellin A-25: Sd[LE0219]
Gibberellin A-29: Sd[LE0219], Lf [LE0122]
Gibberellin A-3: Lf [LE0122]
Gibberellin A-3 iso-lactone: Lf [LE0122]
Gibberellin A-34: Lf [LE0122]
Gibberellin A-4: Lf [LE0122]
Gibberellin A-44: Lf [LE0122]
Gibberellin A-51: Lf [LE0122]
Gibberellin A-53: Lf [LE0122]
Gibberellin A-8: Sd[J15787], Lf [LE0122]
Glycerol, phosphatidyl: Lf [LE0178]
Glycerol, sulfoquinovosyl-diacyl: Lf [LE0178]
Gramisterol: Sd[LE0171]
Hept-5-en-2-ol, 6-methyl: Fr[LE0131]
Hexan-1-ol: Fr[LE0131]
Humulene, alpha: EO 5.38%[LE0143]
Indole-3-acetic acid: Fr, Fl[LE0123]
Interferon, beta: Lf [LE0185]
Ionol, alpha 3-hydroxy: Fr[LE0141,LE0131]
Ionol, alpha 3-oxo: Fr [LE0141,LE0131]
Ionol, alpha 3-oxo O-beta-D-glucopyranoside-tetraacetate: Lf [LE0121]
Ionone, beta 3-hydroxy-7-8-dihydro: Fr[LE0141]
Ionone, beta 7-8-dihydro 3-hydroxy: Fr [LE0131]
Kaempferol: Sd[LE0173], Fr 2 [LE0140]
Lactic acid: Fr [LE0104]
Lanost-8-en-3-beta-ol, 31-nor: Sd[LE0171]
Lanost-9(11)-en-3-beta-ol, 31-nor: Sd[LE0171]
Lanost-9(11)-en-3-beta-ol, 31-nor 2-4-methyl: Sd[LE0171]
Lanosterol: Sd[LE0169]
Lanosterol, 24-dihydro: Sd[LE0169]
Lanosterol, 31-nor: Sd[LE0171]
Leucinopine: Crown gall[LE0201]
Leucinopine lactam: Crown gall[LE0201]
Limonene: EO 7.59%[LE0143]
Linalool: EO 1.84%[LE0143], Fr [LE0131]
Lophenol: Sd [LE0171]
Lophenol, 24-®-ethyl: Sd[LE0171]
Lophenol, 24-®-methyl: Sd [LE0171]
Lupeol: Pl[LE0192], Sd[LE0169,LE0170]
Lutein: Rt[LE0148], Fr 0.5[LE0134]
Lycopene: Fr 21[LE0134]
Lycopene, 1-5-dihydroxy-iridanyl: Fr 3[LE0111]
Lycopene, all-trans: Fr[LE0127]
Lycopene, cis-5-cis-5′: Fr[LE0175]
Lycopene, cis-5: Fr[LE0175]
Lycoperoside A: Fr 0.5[LE0109], Lf 27.3[LE0109]
Lycoperoside B: Lf 20.6, Fr 1.5[LE0109]
Lycoperoside C: Lf 22.6, Fr 4.5[LE0109]
Lycopersicon esculentum carboxypeptidase inhibitor: Fr 1.0[LE0193]
Lycopersicon esculentum furostanol saponin (MP 217-220): Pl[LE0200]
Lycopersicon esculentum saponin TF-1: Pl[LE0200]
Malic acid: Fr[LE0104]
Megastigm-5-en-7-yne-3-9-diol: Fr[LE0141]
Megastigma-5-en-7-yne-3-9-diol: Fr[LE0131]
Melatonin: Fr 32.2 pcg/gm[LE0156]
Mevalonic acid: Fr (unripe) 3-4[LE0220]
Myrcene: EO 0.91%[LE0143]
Myricetin: Fr 0.5[LE0149]
Naringenin: Skin[LE0132]
Naringenin chalcone: Skin[LE0132]
Naringin: Fl, Fr[LE0124]
Neoxanthin, cis-9′: Rt[LE0147,LE0148]
Neoxanthin, trans-9′: Rt[LE0147]
Nerol: Fr[LE0131], EO 0.25%[LE0143]
Neurosporene, cis-5′: Fr[LE0175]
Nicotianamine: Lf 0.05 micromols[LE0130]
Nicotine: Fr 4.3-42.8 ng/gm[LE0144]
Obtusifoliol: Sd[LE0171]
Ocimene, beta cis: EO <0.1%[LE0143]
Ocimene, beta trans: EO 0.42%[LE0143]

Octa-2-7-diene-1-6-diol,2-6-dimethyl cis: Fr[LE0131]
Octa-2-7-diene-1-6-diol, 2-6-dimethyl trans: Fr[LE0131]
Oxalic acid: Fr 0.0263[LE0102]
Pentan-1-ol: Fr[LE0131]
Pentan-1-ol,3-methyl: Fr[LE0131]
Pentan-1-ol,4-methyl: Fr[LE0131]
Penten-2-one: Fr EO[LE0172]
Phellandrene, alpha: EO 1.8%[LE0143]
Phellandrene, beta: EO 34.83%[LE0143]
Phenylethanol,2: Fr[LE0131]
Phenylpropanol,3: Fr[LE0131]
Phytoene-1-2-oxide: Fr[LE0218]
Pinene, alpha: EO 1.82%[LE0143]
Pinene, beta: EO 0.1%[LE0143]
Pregn-16-en-20-one,5-alpha 3-beta-hydroxy: Lf, St[LE0105]
Protein P-14: Fr[LE0135]
Protein P-14-A: Fr[LE0135]
Protein P-14-B: Fr[LE0135]
Protein P-14-C: Fr[LE0135]
Protein P-14-D: Fr[LE0135]
Protein P-14-E: Fr[LE0135]
Protein P-14-F: Fr[LE0135]
Pulcherosine: Pl[LE0110]
Quercetin: Sd[LE0173], Fr 8-13[LE0140,LE0149]
Rishitin: Pl[LE0194]
Rutin: Lf 2.4%[LE0199], Fr, Fl[LE0124]
Sabinene: EO 11.04%[LE0143]
Soladulcidine: Lf, St[LE0105]
Sucrose: Rt[LE0116]
Syringaldehyde: Pl[LE0176]
Terpinene, alpha: EO 7.59%[LE0143]
Terpinene, gamma: EO 0.42%[LE0143]
Terpineol, alpha: Fr[LE0131], EO 0.24%[LE0143]
Terpinolene: EO 0.31%[LE0143]
Tigogenin, neo: Pl[LE0115], Sd [LE0188]
Tomatida-3-5-diene: Lf, St[LE0105]
Tomatidine: Lf, St[LE0105]
Tomatine: Fr (unripe) 197[LE0145], Fr 23-88[LE0153], Lf 0.1%[LE0109]
Tomatine, alpha: Rt 0.01-0.13, Fr (unripe) 0.06-0.46%, Fr 20-170 [LE0154], Lf 0.12-0.65%, St 0.10-0.68%, Fl 0.1-0.7%[LE0160]
Tomatine, gamma: Lf 9.3[LE0109]
Tomato invertase inhibitor: Sd[LE0108]
Tomatoside A: Sd[LE0191]
Tridecan-2-one: EO <0.01%[LE0143], Lf [LE0189]
Tryptamine: Fr 0.29%[LE0161]
Ubiquinone 10: Pl 60[LE0129]
Vanillin: Pl[LE0176]
Violaxanthin,cis-9: Rt [LE0148]
Violaxanthin,trans-9: Rt[LE0148]
Violaxanthin,trans: Rt [LE0147]
Zeatin: Pollen[LE0158]
Zeatin riboside: Pollen[LE0158]
Zeatin riboside,O-beta-D-glucosyl: Pollen[LE0158]
Zeatin,dihydro: Pollen[LE0158]
Zeatin,dihydro O-beta-D-glucosyl: Pollen[LE0158]
Zeatin,dihydro riboside: Pollen[LE0158]
Zeatin,O-beta-D-glucosyl: Pollen[LE0158]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Antifungal activity. Acetone and water extracts of the dried aerial part, at a concentration of 50% on agar plate, were inactive and the ethanol (95%) extract was active on *Neurospora crassa*[LE0223].

Antiallergenic activity. Water extract of the fresh fruit, at a concentration of 100.0 microliters/ml in cell culture, was inactive on Leuk-RBL 2H3 vs biotinylated anti-DNP IgE/avidin-induced beta-hexosaminidase release[LE0157].

Antibacterial activity. Ethanol (95%) and water extracts of the aerial part, on agar plate, were inactive on *Escherichia coli* and *Staphylococcus aureus*[LE0106].

Anticlastogenic activity. The fruit juice, administered intragastrically to male mice at a dose of 1.0 ml, produced weak activity on reticulocytes vs gamma-ray irradiation[LE0120]. Fruit juice, administered intraperitoneally to mice at a dose of 50.0 ml/kg, was active on marrow-cells vs mitomycin, dimethylnitrosamine and tetracycline-induced micronuclei[LE0150].

Anticoagulant activity. Water extract of the fresh leaf, at a concentration of 50.0%, was active on human whole blood. The extract showed brief coagulant activity followed by anticoagulant activity[LE0216].

Antiedema activity. Methanol extract of the dried fruit, administered topically to mice at a dose of 2.0 mg/ear, was active vs 12-0-tetradecanoylphorbol-13-acetate

(TPA)-induced ear inflammation. The inhibition ratio (IR) was 51[LE0138].

Antifungal activity. The dried stem, on agar plate, was active on *Sphacelia segetum*[LE0225]. Water extract of the fresh leaf (1 gram of dried leaf in 1.0 ml of water), on agar plate at a concentration of 50%, was active on *Fusarium oxysporum* F.sp. lentis[LE0152]. The extract, on agar plate, produced strong activity on *Ustilago maydis* and *Ustilago nuda*[LE0204].

Antihistamine activity. Saponin fraction of the crown gall, administered intraperitoneally to guinea pigs at a dose of 40.0 mg/kg, was active vs histamine aerosol[LE0101].

Antimicrobial activity. Ethanol (95%) extract of the dried leaf, applied topically at a dose of 1.0%, was active. The biological activity reported has been patented[LE0181].

Antimutagenic activity. Water extract of the fresh fruit, on agar plate at a dose of 0.4 ml/plate, was active on *Salmonella typhimurium* TA100 vs TRP-P-2 mutagenicity in the presence of S9 mix[LE0212].

Antimycobacterial activity. Ethanol (95%) and water extracts of the aerial part, on agar plate, were inactive on *Mycobacterium tuberculosis*[LE0106].

Antioxidant activity. The fruit juice, at a dose of 100.0 microliters, produced weak activity vs Fentons' reagent-induced lipid peroxidation[LE0120].

Antioxidant activity. Hot water extract of the fresh fruit peel was inactive[LE0221].

Antithyroid activity. The fresh fruit, at a dose of 600.0 gm/person, and the fruit juice, at a dose of 855.0 gm/person taken orally by adults, were inactive. Iodine uptake by the thyroid was measured[LE0224].

Antitumor activity. Ethanol/water (1:1) extract of the dried entire plant, administered intraperitoneally to mice at a dose of 200.0 mg/kg, was inactive on Leuk-P388[LE0206].

Antitumor-promoting activity. Hot water extract of the fresh fruit, in cell culture, produced weak activity on Raji cells vs phorbol myristate acetate-promoted expression of EB virus early antigen[LE0136]. Methanol extract of the fresh fruit, at a concentration of 200.0 mg/ml, was inactive on Raji cells vs EBV activation induced by HPA (40ng/ml)[LE0162].

Antiviral activity. The undiluted fruit juice, in cell culture, produced weak activity on poliovirus 1[LE0196].

Carcinogenesis inhibition. Fruit juice, in the drinking water of male rats, produced weak activity on the urinary bladder vs n-butyl-n-(4-hydroxybutyl)nitrosamine initiated carcinogenesis. The test animals were treated with initiator for 8 weeks prior to treatment with the juice for 12 weeks. The juice-treated group showed a decrease in the number, but not in the incidence, of transitional cell carcinomas, results significant at $p < 0.05$ level[LE0125]. The fresh fruit, taken orally by adults, was active in a case-controlled study of the effect of tomato incidence of digestive tract cancers[LE0151].

Catalase stimulation. Fresh plant juice, at a concentration of 0.5 ml, was inactive[LE0210].

Cosmetic effect. Ethanol (95%) extract of the dried leaf, at a dose of 1.0% applied topically, was active. The biological activity reported has been patented[LE0181].

Cyclooxygenase inhibition. Methanol extract of the fresh fruit, at a concentration of 100.0 mcg/ml, was inactive on rat platelets. There was no inhibition on ether-soluble or ether-insoluble fractions[LE0142].

Cytotoxic activity. Ethanol/water (1:1) extract of the dried aerial part, at a concentration of 25.0 mcg/ml in cell culture, was inactive on CA-9KB[LE0206].

Desmutagenic activity. Aqueous high speed supernatant of the fresh fruit juice (unripe), on agar plate at a concentration of 0.5 ml/plate, was inactive on *Salmonella typhimurium* TA98 vs mutagenicity of L-tryptophane pyrolysis products. The assay was done in the presence of S9 mix[LE0209]. Fresh fruit homogenate, on agar plate at a concentration of 100.0 microliters/disc, was active on *Salmonella typhimurium* TA98 and TA100 vs

1,4-dinitro-2-methyl pyrole mutagenesis[LE0208]. The fresh plant juice, on agar plate at a concentration of 0.5 ml/plate, was active on *Salmonella typhimurium* TA98[LE0210].

Estrogenic effect. Ethanol (95%) extract of the fruit, administered subcutaneously to infant female mice, was inactive[LE0100].

Insecticide activity. Acetone extracts of the dried leaf at a concentration of 33.0%, the dried leaf plus stem at 5.0% and the dried root at 5.0%, were inactive on *Macrosiphium solanifolii* and *Orzyaephilus surinamensis*[LE0222].

Larval growth inhibition. Phenolic fraction of the trichomes (glandular), in the ration at a dose of 0.1%, was active on *Heliothis zea*[LE0213].

Lipid peroxide formation inhibition. Hot water extract of the fresh fruit produced weak activity vs t-butyl hydroperoxide/heme-induced luminol-enhanced chemiluminescence[LE0136].

Lipoxygenase inhibition. Methanol extract of the fresh fruit, at a concentration of 100.0 mcg/ml, was active on rat platelets. Inhibition was 51% on the ether-soluble material. The extract was inactive on the ether-insoluble material; only 1% inhibition was observed[LE0142].

Molluscicidal activity. Aqueous homogenate of the fresh fruits, leaves and roots were inactive on *Lymnaea columella* and *Lymnaea cubensis*. The fresh leaf produced weak activity, LD_{50} 1000 ppm, and the fresh root was inactive[LE0197].

Mutagenic activity. The fruit juice, at a dose of 200.0 microliters on agar plate, produced weak activity on *Salmonella typhimurium* TA100, and was inactive on *Salmonella typhimurium* TA98[LE0128]. Water extract of the fresh fruit, on agar plate, was inactive on *Salmonella typhimurium* TA100[LE0212].

Peroxidase activity. The fresh plant juice, at a concentration of 0.5 ml, was active[LE0210].

Physical chemical study. The fresh fruit, taken orally by adult males undergoing prostatectomy for carcinoma, showed no differences. The levels of cis- and trans-lycopene measured in benign and malignant prostate tissue obtained from the patients revealed that the cis-isomers predominate in the tissue although dietary sources contained predominately the trans-isomer[LE0126].

Protein synthesis inhibition. Buffered extract of the dried seed was active, IC_{50} 32.0 mcg protein/ml[LE0183].

Quinone reductase induction. Acetonitrile extract of the dried fruit, at a concentration of 7.9 mg/gm in cell culture, produced weak activity on hepatoma-mouse-IC7. It was assayed for induction of detoxifying enzyme, an effect that may have anticarcinogenic activity[LE0146].

Toxicity assessment. Ethanol/water (1:1) extract of the aerial part, administered intraperitoneally to mice, produced LD_{50} 825.0 mg/kg[LE0206].

Tumor promoting inhibition. Methanol extract of the fresh fruit, in cell culture at a concentration of 200.0 mcg, was inactive on Epstein-Barr virus vs 12-0-hexadecanoylphorbol-13-acetate-induced Epstein-Barr virus activation[LE0214].

WBC-macrophage stimulant. Water extract of the freeze-dried fruit, at a concentration of 2.0 mcg/ml, was inactive on macrophages. Nitrite formation was used as an index of the macrophage stimulating activity to screen effective foods[LE0224].

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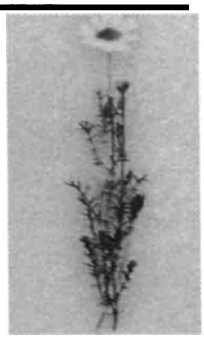
15 Matricaria chamomilla

L.



Common Names

Babounag	Egypt	German Chamomille	England
Babunaj	Arabic countries	Herba de la mera	France
Babunj	Tunisia	Hungarian Chamomile	USA
Bachati	Nicaragua	Kamille	France
Calamido	France	Kamitsure	Japan
Camamilla	Spain	Kamiture	Japan
Camomiha	France	Manzanilla chiquita	Colombia
Camomile	Germany	Manzanilla comun	Colombia
Camomilla comune	Italy	Manzanilla dulce	Colombia
Camomilla	Colombia	Manzanilla romana	Colombia
Camomilla	Italy	Manzanilla	Argentina
Camomirra	Italy	Manzanilla	Bolivia
Campomilla	Italy	Manzanilla	Guatemala
Chamomile	Argentina	Manzanilla	Honduras
Chamomile	England	Manzanilla	Mexico
Chamomile	Estonia	Manzanilla	Nicaragua
Chamomile	India	Manzanilla	Peru
Chamomile	Japan	Manzilla	Guatemala
Chamomille	Mexico	Matricaire	France
Chamomille	Nicaragua	Matricaire	Tunisia
Chrysanthemum	Germany	Matricaris	France
English Chamomile	Japan	Pin heads	Europe
German Chamomile	USA	Sweet Feverfew	England
German Chamomile	USSR	Wild Chamomile	Germany

BOTANICAL DESCRIPTION

A glabrous, branching, erect, and aromatic annual of the COMPOSITAE family. It grows to about 1 m tall with a strong odor when bruised. The leaves, 2 to 3, are pinnately-parted with a narrow, thorny tip. Flowers are large, solitary heads on 2 to 8 cm long, grooved peduncles; The ray florets are white or yellowish, later becoming reflexed, disc florets numerous, yellow, tubular; peduncles 2.5 cm long, dark brown or dusk greenish yellow; achenes with 3–5 faint ribs.

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

ORIGIN AND DISTRIBUTION

M. *Chamomilla* is indigenous to Europe and northwest Asia, and is now naturalized in eastern Australia, North, and South America.

TRADITIONAL MEDICINAL USES

Arabic Countries. Hot water extract of dried flowers is taken orally and is used as a sitz bath for an emmenagogue in Unani medicine[MC0247].

Argentina. Decoction of the dried flowers is taken orally to treat diarrhea and respiratory and urinary tract infections[MC0167]. Infusion is taken orally as a tranquilizer and spasmolytic[MC0172]. Hot water extract of the dried aerial part is taken orally as a febrifuge and for stomach pains and respiratory diseases[MC0267].

Bolivia. Infusion of the dried flower is taken orally as a biliary regulant in bilious and biliary colic[MC0250].

Colombia. Hot water extract of the dried flower[MC0279] and hot water extract of inflorescence[MC0107] are taken orally as an emmenagogue.

England. Hot water extract of the aerial part is taken orally by human adults to expel the fetus at birth[MC0116]. Infusion of the essential oil is taken orally as a sedative and hypnotic. The essential oil is also used externally as an analgesic and anti-inflammatory[MC0140].

Europe. Hot water extract of the flower is taken orally as a carminative, sedative, and tonic[MC0117].

France. Infusion of the aerial part is taken orally as an antispasmodic, to improve circulation as a tonic and vermifuge, and is used externally as an antiseptic[MC0187].

Germany. Butanol extract of the aerial part is used in menstruation powders[MC0113]. Hot water extract of the flower is used as a vaginal douche to induce abortion[MC0102]. The extract is sold as a "quack" abortifacient and a "quack" emmenagogue[MC0289]. A preparation that contains apiol, chamomile, *Artemisia absinthium* and yarrow is used as an abortifacient. In addition, a vaginal lavage containing formaldehyde, soap, alcohol and volatile oil was used[MC0293]. Water extract of the dried flower is taken orally for insomnia, neuralgia and lumbago[MC0173].

Greece. Hot water extract of the flower is taken orally for stomach diseases[MC0114].

Guatemala. Hot water extract of the dried leaf is taken orally as a depurative and for urinary tract infection. Externally, it is used for wounds, ulcers, bruises and sores, pimples, pustules, dermatitis, inflammations, and conjunctivitis[MC0280]. Infusion of the flower and leaf is taken orally for stomach and menstrual pains. The decoction is taken orally to strengthen the womb and for nervousness[MC0179].

Honduras. Hot water extract of the entire plant is taken orally for female illnesses[MC0112].

India. Hot water extract of the leaf is used externally on the genitals as a powerful stimulant[MC0111].

Italy. Infusion of the dried flower head is taken orally as a sedative and laxative. A poultice prepared from the flower is used to treat earache and is placed over the eyes to treat conjunctivitis[MC0283]. Infusion of the dried flower is used as an antispasmodic[MC0282]. Infusion of the flower head (30–40 grams in one liter of water) is taken 2–3 cups per day orally to treat insomnia, biliary calculosis, and as a digestive[MC0183]. Infusion of the inflorescence is taken orally as a digestive, sedative, and externally as an emollient. The decoction is taken orally for gastritis[MC0158].

Mexico. Hot water extract of the aerial part is used as a remedy to prevent miscarriage. The patient is placed on a bed and is given the extract orally 3 to 4 times a day. A gold ring was boiled in the water that was used to make the extract. It is believed that this may avert loss of the fetus[MC0290]. Hot water extract of the dried flower is

taken orally to hasten parturition[MC0235]. Infusion of entire plant is taken orally to treat mild stomach disorders[MC0186]. Infusion of the dried entire plant is taken orally by human adults to diminish hunger. The infusion is mixed with alcohol, *Ruta graveolens*, and an egg[MC0253].

Nicaragua. Decoction of flowers is taken orally to treat belly pain and as a purgative[MC0181]. Decoction of the leaf, mixed with *Tagetes patula*, is used externally for fever[MC0181]. Decoction of the entire plant is taken orally to aid in childbirth and as a digestive[MC0185].

Peru. Hot water extract of the dried flower and leaf is taken orally for heart and nervous diseases, colic, and as a diaphoretic and digestive[MC0277]. Infusion of the flower, leaf and stem is taken orally as an aromatic, digestive, sedative, and carminative for stomachaches[MC0184].

Spain. Decoction and infusion of the dried flower head is taken orally as an intestinal antiseptic and digestive[MC0168].

Tunisia. Hot water extract of the dried aerial part is taken orally for stomach pain and aerophagy[MC0258].

USA. Essential oil of the dried flower is taken orally as an antispasmodic and a carminative in flatulency, colic and cramps. Hot water extract of the dried flower is taken orally as an emetic. One to 2 cups of the warm infusion is then taken as an emetic[MC0303]. Fluid extract of the flower is taken orally for amenorrhea, as a mild tonic and antispasmodic[MC0118]. The hot water extract is taken orally as a spasmolytic and an anti-inflammatory[MC0287]. Hot water extract of the aerial part is taken orally as an emmenagogue and as a nervine[MC0221].

USSR. Hot water extract of the flower is taken orally for bacillary dysentery, especially in children[MC0288]. Infusion of the dried flower is used as an eyewash for styes and runny eyes[MC0208]. The hot water extract is taken orally as a blood purifier[MC0272].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

1-8 Cineol: Fl[MC0274]
2-(Butyn-2-ylid-3-ene)-dihydro furan(5-spiro-2-)-tetrahydrofuran: Fl[MC0126]
6-Methoxy kaempferol: Fl[MC0226]
6-Methyl-hept-5-en-2-one: Fl EO 0.07%[MC0147]
3,6-Dimethoxy quercetin: Fl[MC0226]
6,7-Dimethoxy quercetin: Fl[MC0226]
Aesculetin: Fl[MC0152]
Alpha alanine: Fl[MC0291]
Alpha bisabolol (+): EO[MC0134]
Alpha bisabolol (-): EO, Fl 0.252%[MC0273]
Alpha bisabolol (DL): Fl[MC0307]
Alpha bisabolol oxide A: Fl 8.93-16.85%[MC0197, MC0159]
Alpha bisabolol oxide B(-): Fl[MC0136]
Alpha bisabolol oxide B: Fl 23.54%[MC0159]
Alpha bisabolol oxide C(-): Fl[MC0262]
Alpha bisabolol: Fl, Fl EO 3.0-43%[MC0196]
Alpha bisabolone oxide(-): Fl[MC0262]
Alpha bisabolone oxide: Fl EO 5.21%[MC0159]
Alpha cubebene: Fl[MC0262]
Alpha farnesene: Rt, EO[MC0224]
Alpha muurolene: EO[MC0127]
Alpha terpineol: Fl EO 900[MC0147]
Anisic acid: Fl[MC0228]
Anthecotulide: Fl[MC0265]
Anthemis cotula sesquiterpene lactone 1: Aer[MC0237]
Apigenin glucoside: Fl[MC0135]
Apigenin glycoside: Fl[MC0123]
Apigenin-7-(3-0-acetyl)-glucoside: Fl[MC0234]
Apigenin-7-(6-0-acetyl)-glucoside: Fl[MC0163]
Apigenin-7-0-beta-D-glucoside-2-3-diacetate: Fl[MC0239]
Apigenin-7-0-beta-D-glucoside-2-acetate: Fl 0.36%[MC0230]
Apigenin-7-0-beta-D-glucoside-3-4-diacetate: Fl[MC0239]
Apigenin-7-0-beta-D-Glucoside-3-acetate: Fl[MC0155]
Apigenin-7-0-beta-D-glucoside-4-acetate: Fl[MC0155]
Apigenin-7-0-beta-D-glucoside-6-acetate: Fl[MC0155]
Apigenin-7-0-glucoside isomer: Fl, Lf[MC0305]
Apigenin-7-acetyl-0-beta-D-glucoside: Fl[MC0198]
Apigenin-7-acetyl-glucoside: Fl 1.76-2.17%[MC0242]

Apigenin-7-beta-(6-0-acetyl)-glucopyranoside: Pl[MC0201]
Apigenin-7-beta-(6-0-acetyl)-glucoside: Fl[MC0206]
Apigenin-7-beta-D-glucopyranoside: Pl[MC0201]
Apigenin: Fl 0.08-5.22%[MC0105, MC0229]
Apigetrin: Fl 2.39%[MC0153]
Apiin: Fl[MC0234]
Axillarin: Fl[MC0232]
Azulene: Pl, Fl EO 10%[MC0294, MC0217]
Beta bisabolol oxide B: EO 11.17%[MC0197]
Beta caryophylene: Rt[MC0262], Rt EO 2[MC0248], Fl EO 0.13%[MC0147]
Beta elemene: Fl[MC0147]
Beta farnesene: Lf, Fl 0.04-0.28%[MC0182, MC0157]
Beta sitosterol: Fl[MC0144]
Bisabolene oxide: EO[MC0227]
Bisabolol oxide 1: EO 1.65%[MC0238]
Bisabolol oxide A: Lf, Fl 0.15-0.59%[MC0182, MC0157]
Bisabolol oxide B: Fl, Lf[MC0213, MC0182]
Bisabolol oxide C: EO[MC0193]
Bisabolol oxide II: EO 2.73%[MC0238]
Bisabolol: Fl, Lf, Fl EO 42%[MC0260]
Bisabolone oxide A: EO[MC0246]
Bisabolone oxide: Fl EO 7.76%, Fl 100-500[MC0147, MC0157]
Borneol acetate: Fl[MC0245]
Borneol: Fl[MC0274]
Boron: Fl 80.4[MC0110]
Cadinene: Fl[MC0262]
Caffeic acid: Fl[MC0228]
Calamene: Fl[MC0262]
Car-3-ene: EO[MC0127]
Caryophyllene epoxide: Rt[MC0262]
Caryophyllene oxide: Fl EO 0.17%[MC0147]
Caryophyllene: Fl EO[MC0274]
Cerotic acid: Fl[MC0105]
Chamaviolin: EO[MC0127], Fl[MC0262]
Chamazulene: Fl 260-1170[MC0241,MC0273], EO 1.26-23.00%[MC0196], Fl EO 3.80-8.19%[MC0284]
Chamillin: Fl[MC0299]
Chamomillaester 1: Rt[MC0262],Rt EO 10[MC0248]
Chamomillaester II: Rt EO 2[MC0248]
Chamomillol: Rt EO 87[MC0248]
Choline: Fl 70-3,800[MC0105,MC0109]
Chrysoeriol: Fl[MC0232]
Chrysosplenetin: Fl[MC0306,MC0232]
Chrysosplenol: Fl[MC0232]
Cinnamoyl-beta-D-glucopyranoside,1-(2-hydroxy-4-methoxy): Pl[MC0128]
Cis beta farnesene: Fl EO 15.97%[MC0159]
Cis bisabolol oxide 1: EO 1.65%[MC0238]
Cis caryophyllene: Rt EO 6[MC0248]
Cis cinnamic acid,4-methoxy,2-0-beta-D-glucoside: Fl 1.71%[MC0156]
Cis cinnamic acid,4-methoxy,2-beta-D-glucoside: Fl[MC0142]
Cis dicycloether: Fl EO 9.64%[MC0147]
Cis en-yne-bicyclo ether: Fl[MC0163], Rt EO 12[MC0248]
Cis ene-yne-bicylco ether: EO[MC0166]
Cis spiro-(4,4)-non-3-ene,2-hexa-2,4-diin-1-ylidene-1,6-dioxa: Fl[MC0200]
Cis-trans en-yne-bicyclo ether: Rt, St, Fl[MC0262]
Cis-trans farnesol: Fl EO 0.42%[MC0147]
Cosmosiin: Fl 0.51-6.62%[MC0156,MC0230]
Cosmosioside: Fl[MC0304]
Coumarin: Fl[MC0152]
Cynaroside: Fl[MC0259,MC0305]
Daucosterol: Fl 300[MC0144]
Dioxaspiro-(4-4)-non-3-ene,1-6,2-(hexa-2-4-diynylidene): Fl[MC0218]
En-yne-bicyclo ether: Fl 0.27-1.03%[MC0157]
Essential oil: Fl 0.46-0.85%[MC0286], Call Tiss[MC0150]
Eupaletin: Fl[MC0226]
Eupalitin: Fl[MC0232]
Eupatoletin: Fl[MC0232]
Farnesene: EO 1.59-27.72%[MC0249,MC0197]
Farnesol: Fl EO[MC0274]
Fructose: Fl[MC0220]
Gamma amino butyric acid: Fl[MC0190]
Gamma cadinene: Fl EO 0.75%[MC0159]
Gamma terpinene: EO[MC0127]
Geraniol: Fl EO 0.24[MC0147]
Glucosamine (D): Fl[MC0220]
Glucose: Fl[MC0220]
Guaiazulene: EO[MC0103], Fl[MC0245]
Herniarin: Fl 0.039-0.081%[MC0233]
Histidine (L): Fl[MC0291]
Iso rhamnene: Fl[MC0228]
Iso scopoletin: Fl[MC0152]
Iso borneol: Fl EO 0.1%[MC0147]
Jaceidin: Fl[MC0226,MC0232]
Leucine (DL): Fl[MC0291]
Levulose: Fl[MC0105]
Linalool: Fl EO 0.57%[MC0147]
Linoleic acid: Fl[MC0105]
Luteolin-7-0-beta-D-rutinoside: Fl, Lf[MC0305]

Luteolin: Fl[MC0234,MC0228]
Lysine (DL): Fl[MC0291]
Matricaria chamomilla sterol (MP122-123): Fl[MC0105]
Matricaria chamomilla sterol glucoside (MP 158-160): Fl[MC0105]
Matricaria polysaccharide PS-1: Fl[MC0146]
Matricaria polysaccharide PS-2: Fl[MC0146]
Matricaria polysaccharide PS-3: Fl[MC0146]
Matricin: Fl[MC0165]
Matricine: Fl EO 3.52%[MC0147]
Menthol acetate: Fl EO 0.17%[MC0147]
Menthol: Fl[MC0147]
Myrcene: Fl[MC0274]
Nerol: Fl EO 0.65%[MC0147]
Nerolidol: Fl[MC0274]
Nicotinic acid: Fl 0.88 mg/100 gm[MC0108]
Ocimene: Fl EO 0.11%[MC0147]
Oleanolic acid: Fl 70[MC0144]
Oleic acid: Fl[MC0105]
Palmitic acid: Fl[MC0105]
Patchoulene: EO[MC0212]
Patuletin: Fl[MC0234]
Patulitrin: Fl[MC0304]
Pectic acid: Fl[MC0194]
Pentacosan (N): Fl 800-1100[MC0157]
Phylloquinone: Lf[MC0131]
Pulegone: Fl EO[MC0274]
Quercetin: Fl[MC0228]
Quercimeritrin: Fl[MC0304]
Rutin: Fl[MC0234]
Salicyclic acid: Fl[MC0105]
Scopoletin: Fl[MC0152]
Serine: Fl[MC0291]
Skimmin: Lf, St[MC0202]
Spathulenol: Fl EO 3.59-9.11%, Fl 120-140[MC0231]
Spinacetin: Fl[MC0232]
Stearic acid: Fl[MC0105]
Stigmasterol: Fl 20[MC0144]
Sucrose: Fl[MC0105]
Syringic acid: Fl[MC0228]
T cadinol: Fl EO 0.36%[MC0147]
Terpinen-4-ol: Fl EO 700[MC0147]
Thujone: Fl[MC0149]
Trans alpha farnesene: Rt EO 3[MC0248], St, Fl[MC0262]
Trans beta farnesene: Rt EO 87[MC0248], Fl, St[MC0262]
Trans bisabolol oxide B(-): EO[MC0166]
Trans bisabolol oxide: EO[MC0151]
Trans cinnamic acid,4-methoxy,2-0-beta-D-glucoside: Fl 0.62%[MC0156]
Trans cinnamic acid,4-methoxy,2-beta-D-glucoside: Fl[MC0142]
Trans dicycloether: Fl EO 3.33%[MC0147]
Trans en-yne-bicyclo ether: Fl, Rt EO 9[MC0248]
Trans ene-yne-bicyclo ether: EO[MC0166]
Trans farnesene: EO[MC0166]
Trans farnesol: Fl EO 0.32%[MC0147]
Trans nerolidol: Fl EO 0.42%[MC0147]
Trans spiro-(4,4)-non-3-ene,2-hexa-2,4-diin-1-ylidene-1,6-dioxa: Fl[MC0200]
Triacontane (N): Fl 0.16%[MC0105]
Tryptophan: Fl[MC0291]
Umbelliferone methyl ether: Fl 0.028%[MC0105]
Umbelliferone: Fl 100[MC0233]
Vanillic acid: Fl[MC0228]
Xanthoxylin: EO[MC0127]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

ACTH level decrease. The essential oil, administered to ovariectomized rats by inhalation at a dose of 0.7 ml/animal, was active. There was a decreased restriction stress-induced increase of plasma ACTH levels. The response was enhanced by co-treatment with diazepam and inhibited by flumazenile[MC0140].

ACTH level increase. The essential oil, administered to ovariectomized rats by inhalation at a dose of 0.7 ml/animal, was active vs restriction stress[MC0137].

Allergenic activity. Ethanol (95%) extract of the fresh entire plant was active when applied externally to human adults at a dose of 1.0%. Of the 12 people with contact allergy to chrysanthemum, 3 also showed contact allergy to this plant[MC0174]. Flavonoid fraction of the dried flower, applied externally to human adults, was active. The reaction is likely due to the anthecotulid content[MC0169]. Hot water extract of the dried flower, taken orally by human adults, was active. A case report is given of a 24-year-old male who had noted periodically that he experienced mild adverse reactions after

contact with the plant. He avoided contact with the plant for what he believed to be sufficient time so that the reaction would not recur and then became involved in harvesting the plant. Exposure to the plant resulted in a strong spurious dermatitis: edema, redness, blistering and pustule formation on the dorsal surface of both hands. He experienced a cutaneous reaction with the flower, slightly positive reaction with a decoction of the flower and negative reaction with the leaf. Further, the patient, having drunk a cup of chamomile infusion, presented very distinct general reactions of the anaphylactoid type: slow pulse, pale and goose-like skin, asthma and leukopenia. It was necessary to administer epinephrine to alleviate the symptoms[MC0301]. Infusion of the dried flower, applied ophthalmically to human adults, was active. Seven patients with a history of asthma or seasonal rhinitis showed severe conjunctivitis associated with lid angioedema after chamomile tea eyewashes. All showed positive skin tests in response to tea and pollen, and to *Artemesia vulgaris* pollen. Prick test with heated tea was also positive, but ingestion was well tolerated. Large amounts of pollen were found in the tea. The ELISA test showed IgE activity in patients, but not healthy controls[MC0208]. Infusion of the dried flower, taken orally by female human adults, was active. A case was reported of contact dermatitis after the ingestion of chamomile tea[MC0145]. Hot water extract of the flower, taken orally by female human adults at a dose of 150.0 ml, was active [MC0122]. The sesquiterpene lactone fraction of the dried entire plant was active. Four and one half percent of the patients tested positive on patch test (for Compositae) or to extracts of 5 common composites (*Chrysanthemum parthenium*, *Matricaria chamomilla*, *Tanacetum vulgare*, *Achillea millefolium* and *Arnica montana*). Only 17 of 30 were positive to both[MC0161]. Undiluted ether extract of the dried flower, applied by patch test to adults of both sexes, was active[MC0223].

Antianaphylactic activity. Water extract of the dried flower head, at a concentration of 1.0 mcg/ml, produced weak activity on rat LEUK-RBL 2H3 vs biotinyl IgE-avidin complex-induced degranulation of Beta-hexosaminidase[MC0177].

Antibacterial activity. Decoction of the dried flower, on agar plate, was inactive on *Pseudomonas aeruginosa*[MC0167]. Water extract, at a concentration of 1.0 mg/ml, was inactive on *Salmonella typhi*[MC0139]. The hot water extract, at a concentration of 62.5 mg/ml, was inactive on *Escherichia coli* and *Staphylococcus aureus*[MC0162]. Essential oil, on agar plate, was active on *Moraxella glucidolytica* and several gram-positive organisms[MC0215]. Essential oil was active on *Erwina amylovora* on agar plate, MIC 450.0 mg/liter[MC0211]. Ethanol (30%) extract of the flower, on agar plate, was inactive on *Bacillus subtilis*, *Escherichia coli*, *Serratia marcescens*, and *Staphylococcus aureus*. Ethanol (95%) extract was active on *Escherichia coli* and inactive on *Staphylococcus aureus*. The water extract was active on *Escherichia coli* and inactive on *Staphylococcus aureus*[MC0125]. Ethanol (95%) extract of the dried flower, at a concentration of 1.25 mg/ml on agar plate, was active on *Bacillus megaterium*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, results significant at $p < 0.05$ level. It was also active on *Staphylococcus aureus* and *Staphylococcus epidermidis*, with results significant at $p < 0.05$ level, and *Streptococcus mutans*, *Streptococcus salivarius*, and other *Streptococcus* species. A concentration of 10.0 mg/ml was active on *Bacillus megaterium* and *Escherichia coli*, results significant at $p < 0.05$ level. A concentration of 5.0 mg/ml was active on *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Streptococcus salivarius*, results significant at $p < 0.05$ level[MC0252]. Ethanol/water (1:1) extract of the dried flower, at a concentration of 50.0 microli-

ters on agar plate, was inactive on *Escherichia coli*, *Salmonella enteritidis*, *Salmonella typhosa*, *Shigella dysenteriae*, and *Shigella flexneri*[MC0175]. Ether extract of the aerial part, on agar plate, was inactive and the water extract was active on *Bacillus subtilis*, *Escherichia coli* and *Streptococcus sobrinus*. Ethanol (95%) extract was active on *Escherichia coli*, and *Streptococcus sobrinus*, and was inactive on *Bacillus subtilis*[MC0281]. Essential oil of the flower, at a concentration of 8.0% in broth culture, was inactive on *Escherichia coli* and *Pseudomonas aeruginosa*, and active on *Bacillus subtilis*, MIC 0.6%, and *Staphylococcus aureus*, MIC 0.7%[MC0297]. Tincture of the dried leaf (10 gm of leaves in 100 ml ethanol), on agar plate at a concentration of 30.0 microliters/disc, was inactive on *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*[MC0280]. Water extract of the flower, on agar plate, was active on *Bacillus mesentericus*, *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus*[MC0192]. Water extract of the entire plant, in broth culture, was inactive on *Staphylococcus aureus* and *Streptococcus faecium*[MC0129].

Antiburn effect. Essential oil of the flowering tops produced weak activity when applied externally to female adults. A randomized single-blind study was performed to determine the efficacy of chamomile cream on acute radiation skin reactions in 50 female patients. With application of the cream twice daily 30 minutes prior to irradiation and at bedtime, most of the patients reported light erythema after irradiation. Results were similar to that of almond oil. Two allergic reactions to chamomile cream were reported[MC0138].

Anticonvulsant activity. Ethanol (95%) extract of the dried flower, administered intraperitoneally to mice at a dose of 2-4 ml/kg, was active vs supramaximal electroshock-, and corazol-induced convulsions. A dose of 4.0 mg dried plant material/kg was inactive vs strychnine-induced convulsions[MC0115]. Water extract of the dried leaf and stem, administered intraperitoneally to mice at a dose of 0.2 ml/animal, was active vs picrotoxin-induced convulsions, results significant at $p < 0.01$ level[MC0271].

Anticrustacean activity. Hot water extract of the dried leaf at a concentration of 20.0% was active on *Artemia salina*. Assay system was intended to predict for antitumor activity[MC0154].

Antidiarrheal activity. Water/alcoholic extract of the dried flower, taken orally by children of both sexes at a dose of 5.0 ml, was active. A prospective, double-blind, randomized, multicenter parallel group study was done with children (6 months to 5.5 years of age) with acute non-complicated diarrhea. They received either a preparation containing apple pectin and chamomile extract (diarrhoesan n=39) or placebo (n=40), in addition to the usual rehydration and realimentation diet. At the end of 3 days of treatment, the diarrhea had ended significantly by at least 5.2 hours, results significant at $p < 0.05$ level[MC0143].

Antieczema effect. Flavonoid fraction of the dried flower, taken orally by human adults, was active vs eczema of the lower extremities[MC0169]. Essential oil of the flower, on agar plate, was active on *Trichophyton mentagrophytes* and *Trichophyton rubrum*[MC0132]. Essential oil, on agar plate, was active on *Lenzites trabea*, and inactive on *Lentinus lepideus* and *Polyporus versicolor*[MC0119]. Ethanol (95%) extract of the dried root, on agar plate, was inactive on *Alternaria kikuchiana*, *Aphanomyces euteiches*, *Solani phaseoli*, *Phomopsis mali*, and *Rhizoctonia solani*[MC0141]. Ethanol/water (1:1) extract of the dried flower, at a concentration of 500.0 mg of dried plant material/ml on agar plate, was active on *Trichophyton mentagrophytes*. It was inactive on *Aspergillus fumigatus*, *Aspergillus niger*, *Botrytis cinerea*, *Fusarium oxysporum*, *Penicillium digitatum*, and *Rhizopus nigricans*[MC0270]. Fresh entire plant, at a concentration of 1.0

gm/ml on agar plate, was inactive on *Ceratocystis ulmi*, *Cytospora* species, *Fomes annosus*, and *Pestaalotia funerea*[MC0255]. Hot water extract of the dried flower, at a concentration of 62.5 mg/ml on agar plate, was inactive on *Aspergillus niger*[MC0162]. Water extract of the dried flower, on agar plate, was active on *Microsporum cookei*[MC0170].

Antihyperglycemic activity. Powdered dried flower, administered intragastrically to rats at a dose of 0.75 gm/kg, was inactive vs streptozotocin-induced hyperglycemia[MC0188].

Anti-inflammatory activity. Essential oil, administered ophthalmically to a guinea pig, was active vs mustard oil irritation[MC0292]. The essential oil, taken orally by adults, was active vs UV-induced erythema[MC0298]. The essential oil, at a concentration of 90.0%, was active when applied externally. The biological activity has been patented[MC0251]. Essential oil of the dried entire plant, applied externally, was active vs irradiation erythema on human adults, pigs and rats. Ophthalmic application was active on rabbits vs mustard oil irritation of the rabbit eye[MC0294]. Ethanol (30%) extract of the flower, at a concentration of 12.5%, was active vs UV-induced erythema on the mouth of cats. When administered intravenously to rats at a dose of 3.2 ml/kg, weak activity was produced vs heat-induced inflammation. Oral administration to female rats, at a dose of 2.8 ml/kg, produced weak activity vs carrageenin-induced pedal edema [MC0222]. Ethanol (80%) extract of the dried flower, administered intraperitoneally to rats at a dose of 400.0 mg/kg, was active vs carrageenin-induced pedal edema[MC0204]. Flavonoid fraction of the dried flower, applied externally to human adults, was equivocal vs UV-induced erythema. When applied to mice, it was active vs croton oil-induced edema and carrageenin-induced pedal edema[MC0169]. Infusion of the dried flower, administered externally to male mice at a dose of 0.08 mg/animal, was inactive vs croton oil-induced edema. A dose of 0.25 mg/animal produced weak activity, and an 8.5% reduction of edema induced by croton oil was observed, results significant at $p < 0.05$ level. A dose of 0.75 mg/animal was active, 23.4% reduction of edema induced by croton oil was observed, results significant at $p < 0.02$ level[MC0256]. Water extract of the entire plant, taken orally by adults, was inactive in a phase III, double-blind, placebo-controlled study of efficacy of the extract against 5-fluorouracil-induced oral mucositis[MC0176].

Antimalarial activity. Water extract of the dried aerial part was inactive on *Plasmodium berghei* in mice[MC0129].

Antimutagenic activity. Infusion of the flower, at a concentration of 50.0 mg/plate on agar plate, was active on *Salmonella typhimurium* TA98 vs 2-Amino-3-methylimidazo[4,5-F]quinoline-, 2-Amino-3,8-Dimethylimidazoxaline, 2-Amino-1-methyl-6-phenylimidazo[4,5-B]-pyridine-, and 2-Amino-3,4-Dimethylimidazo[4,5-F]quinoline-induced mutagenesis. Metabolic activation was required to obtain positive results[MC0180]. Infusion of the flower, at a concentration of 100.0 microliters/disc on agar plate, was inactive on *Salmonella typhimurium* TA98 vs 2-Amino-anthracene-induced mutagenicity, and TA100 vs ethylmethanesulfonate-induced mutagenicity. Metabolic activation was required for activity[MC0189]. Methanol extract of the dried leaf and stem, at a concentration of 50.0 microliters/disc on agar plate, was inactive on *Bacillus subtilis* NIG-1125 His Met and *Escherichia coli* B/R-WP2-TRP[MC0261]. Water extract of the flower, at a concentration of 50.0 mg of the plant material, was active on *Salmonella typhimurium* TA98 vs TRP-P-2-induced mutation. Metabolic activation was required for activity[MC0203].

Antimycobacterial activity. Essential oil of the flower, on agar plate, was active on

Mycobacterium phlei[MC0132]. Ethanol (95%) extract of the flower, on agar plate, was inactive, and the water extract produced weak activity on *Mycobacterium tuberculosis*.[MC0125].

Antinematodal activity. Ethanol (95%) extract of the entire plant was inactive on *Meloidogyne incognita*[MC0120].

Antipyretic activity. Hot water extract of the flower, taken orally by adults, was active[MC0285].

Antispasmodic activity. The essential oil was active on guinea pig ileum vs histamine-induced contractions, ED_{50} 1.15 mg/ml, results significant at p <0.05 level; vs barium-induced contractions, ED_{50} 1.22 mg/ml, results significant at p <0.05 level; vs bradykinin-induced contractions, ED_{50} 2.24 mg/ml, results significant at p <0.05 level; vs ACH-induced contractions, ED_{50} 2.47 mg/ml, results significant at p <0.05 level and vs 5-HT-induced contractions, ED_{50} 2.54 mg/ml, results significant at p <0.05 level[MC0234]. Ethanol (30%) extract of the flower, at a concentration of 3.0%, was active on guinea pig ileum vs ACh- and histamine-induced spasms[MC0222]. Ethanol (95%) extract of the dried flower, at a concentration of 100.0 mcg/ml, was active on guinea pig ileum vs histamine- and barium-induced contractions. Water extract, at a concentration of 100.0 mcg/ml, was inactive on guinea pig ileum vs histamine-induced contractions, and produced weak activity vs barium-induced contractions[MC0254]. Ethanol (95%) extract of the dried flower, at a concentration of 2.5 ml/liter, was active on guinea pig ileum vs ACH- and histamine-induced contractions[MC0278]. Water and methanol extracts of the dried flower and leaf were active on the small intestine of rabbits[MC0295]. The essential oil was active on guinea pig ileum vs musculotropic spasms, ED_{50} 0.038 mg/ml. The hydro-alcoholic extract, at a concentration of 0.038 mg/ml, was active on guinea pig ileum vs barium chloride-, acetylcholine-, histamine-, sertonin- and brady-kinin-induced spasms[MC0134].

Antispirochetal activity. Ethanol (95%) extract of the dried flower, at a concentration of 0.31 mg/ml on agar plate, was active on *Leptospira icterohaemorrhagiae*, results significant at p <0.05 level[MC0252].

Antitrichomonal activity. Water extract of the dried flower, in broth culture, was active on *Trichomonas vaginalis*. The biological activity reported has been patented[MC0164]. Ethanol (95%) extract of the dried flower, at a concentration of 0.31 mg/ml in broth culture, was active on *Trichomonas vaginalis*, results significant at p <0.05 level[MC0252].

Antitumor activity. Ethanol and water extracts of the flower, administered intraperitoneally to mice at doses of 100.0 mg/kg, were inactive on Sarcoma 180 (ASC)[MC0243]. Ethanol/water (1:1) extract of the entire plant, administered intraperitoneally to the mouse, was inactive on LEUK-P388 [MC0106]. Water extract of the dried aerial part, administered intraperitoneally to mice at a dose of 400.0 mg/kg, was inactive on LEUK-P388[MC0129].

Antiulcer activity. Ethanol (30%) extract of the flower, administered orally to female rats at a dose of 0.5 ml/kg, was inactive vs Shay rat test[MC0222]. Ethanol (40%) extract of the flower, administered orally to male rats at a dose of 1.0 ml/animal, was active vs ethanol-induced ulcers[MC0219]. Hot water extract of the dried flower, administered by gastric intubation to mice at a dose of 1.102 gm of crude plant material/kg of body weight, was inactive on ulcers induced by stress[MC0178].

Antiviral activity. Butanol and water extracts of the dried entire plant, at a concentration of 1.25 mg/ml in cell culture, were active on Herpes virus type 1 and Poliovirus ll. The ether extract, at a concentration of 5.0 mg/ml, was inactive and the ethanol (95%) extract, at a concentra-

tion of 5.0 mg/ml, was active. Ethyl acetate extract, at a concentration of 2.5 mg/ml, was active on Poliovirus II and Herpes virus type 1[MC0257]. Ethanol (70%) extract of the dried flower, at a concentration of 100.0 microliters/ml in cell culture, was active on Poliovirus I[MC0199]. Ethanol (95%) and water extracts of the dried aerial part, at a concentration of 15.0 mg/ml in cell culture, were inactive on Rinderpest virus[MC0275]. Hot water extract of the dried flower and leaf, administered intraperitoneally to mice at a concentration of 5.0%, was active on Encephalitis virus[MC0210]. Water extract of the dried flower, at a concentration of 10.0% in cell culture, was inactive on Herpes virus type 2, Influenza virus A2 (Manheim 57), Poliovirus II and Vaccinia virus[MC0263].

Antiyeast activity. The essential oil of the flower, on agar plate, was active on *Candida albicans*[MC0132]. Ethanol (95%) extract of the dried flower, at a concentration of 1.25 mg/ml, was active[MC0252], results significant at $p < 0.05$ level. Ethanol/water (1:1) extract, at a concentration of 500.0 mg of dried plant material /ml, was inactive on *Candida albicans* and *Saccharomyces pastorianus*[MC0270]. Flower essential oil, at a concentration of 0.7% in broth culture, was active on *Candida albicans*[MC0297]. Tincture of the dried leaf (10 gm of leaf in 100 ml of ethanol), on agar plate at a concentration of 30.0 microliters/disc, was inactive on *Candida albicans*[MC0280].

Carcinogenesis inhibition. Flavonoid fractions of the flower, applied externally to mice, were active vs DMBA-initiated and TPA-promoted skin lesions[MC0169].

Cholecystokinin receptor binding effect. The dried flower, at a concentration of 2.0 mcg/ml, was active[MC0173].

Choleretic activity. The essential oil, administered orally to dogs and cats at a dose of 0.01 ml/kg, was active. There was an increase of the cholesterol content of the bile[MC0130]. Hot water extract of the dried flower, administered by gastric intubation to dogs, produced strong activity. Animals had chronic fistula of the gall bladder according to Schwann-Dastre. The extract induced a marked stimulating effect on the secretory function of the liver[MC0296]. Ten percent infusion of hot water extract of the flower, administered orally to dogs at a dose of 50.0 ml/animal, was active[MC0121].

CNS depressant activity. The essential oil, administered by gastric intubation to rats at a dose of 25.0 mg/kg, was inactive. A dose of 500.0 mg/kg was equivocal[MC0240]. Hot water extract of the flower, taken orally by adults of both sexes at a dose of 180.0 ml/person, was active. Twelve hospitalized patients in a study (5 males and 7 females) had some form of heart disease. Two teabags of chamomile per 6 ounces of hot water were taken. Ten of the 12 subjects fell into a deep sleep 10 minutes after drinking the tea. The duration of the effect was 90 minutes[MC0100]. Methanol extract of the dried flower, administered intracerebrally to rats, was active. Locomotor activity was tested[MC0190].

CNS effects. Tincture of the dried flower, taken orally by adults at a dose of 10.0 ml/person, diminished the acuteness of hearing[MC0302].

Cytotoxic activity. Ethanol/water (1:1) extract of the entire plant was inactive on CA-9KB in cell culture, ED_{50} >20.0 mcg/ml[MC0106]. Water extract of the dried aerial part was inactive on CA-9KB in cell culture[MC0129]. Water extract of the dried flower, at a concentration of 10.0% in cell culture, was inactive on HELA cells[MC0263].

Delayed type cutaneous hypersensitivity stimulation. Ethanol (95%) extract of the dried flower, applied externally on adults at a concentration of 0.2%, was active[MC0216].

Diuretic activity. Decoction of the dried leaf, administered nasogastrically to rats at a dose of 1.0 gm/kg, was inactive[MC0276].

Embryotoxic effect. Ethanol (40%) extract of the dried flower, administered orally to pregnant rats at a dose of 1.6 ml/kg, was inactive[MC0225].

Fertilization inhibition. Ethanol (40%) extract of the dried flower, administered orally to female rats at a dose of 1.6 ml/kg, was inactive[MC0225].

GABA receptor blocking effect. The dried flower, at a concentration of 2.0 mcg/ml, was active[M23856].

Gastric antisecretory activity. Ethanol (30%) extract of the flower, administered by perfusion to female rats at a concentration of 1.0%, was inactive[MC0222].

Glutamate receptor blocker. The dried flower, at a concentration of 2.0 mcg/ml, was active on quisqualate, kainate and NMBA receptors[MC0173].

Glutathione S-Transferase induction. The essential oil, administered intragastrically to mice at a dose of 30.0 mg/animal every 2 days for a total of 3 doses, was inactive on the small intestine, liver and stomach[MC0214].

GRAS Status. GRAS status was approved by the United States of America Food and Drug Administration in 1976 (Sect. 582.10) as a flavoring agent[MC0148].

Hepatotoxic activity. Ether extract of the flower, administered by gastric intubation to dogs, was active. Chronic dosing produced fatty degeneration of the liver[MC0293].

Histamine release inhibition. Flavonoid fraction of the dried flower was active on human polymorphonuclear leukocytes vs antigen-stimulated release[MC0169].

Hypertensive activity. Hot water extract of the flower, taken by adults of both sexes at a dose of 180.0 ml/person, produced weak activity. Twelve hospitalized patients in a study (5 males and 7 females) with some form of heart disease were given 2 teabags of chamomile per 6 ounces of hot water. Small but significant increase in mean brachial arterial pressure was shown[MC0100].

Hypoazotemic activity. The essential oil, administered orally to rabbits at a dose of 0.05 gm/animal, was active[MC0104].

Hypotensive activity. The essential oil, at a concentration of 0.2 ml/kg, was active. There was a decrease in the frequency of cardiac contractions and decreased respiration[MC0130].

Immunostimulant activity. The polysaccharide fraction of the dried entire plant, administered intraperitoneally to mice at a dose of 10.0 mg/kg, was active vs clearance of colloidal carbon[MC0264]. The polysaccharide fraction of the dried flower, administered intraperitoneally to rats, was active. Response to the sheep RBC was enhanced. Response to lipopolysaccharide was not enhanced unless animals had completed a physical task such as swimming[MC0160]. Polysaccharide fraction of the flower, administered intraperitoneally to mice at a dose of 10.0 mg/kg, was active vs clearance of colloidal carbon[MC0266].

Insect feeding deterrent. Benzene extract of the flower, at a dose of 5.0%, was active on female *Spodoptera litura*[MC0195].

Insecticide activity. Water extract of the dried leaf and stem, at low concentration, was inactive on *Culex quinquefasciatus*[MC0124].

Insulin level increase. Powdered dried flower, administered intragastrically to rats at a dose of 0.75 gm/kg, was inactive[MC0188].

Larvicidal activity. Acetone extract of the dried entire plant was inactive on *Aedes aegypti*[MC0300]. Ether extract of the flower was active on *Culex pipens* larvae, ED_{50} 28.84 ppm[MC0101].

Lipoxygenase inhibition. Flavonoid fraction of the dried flower was active[MC0169].

Liver regeneration stimulation. The essential oil, administered subcutaneously to partially hepatectomized male rats at a dose of 50.0 mg/animal daily for 7 days, was inactive[MC0236].

Local anesthetic effect. Ethanol (30%) extract of the flower, at a concentration of

8.0% applied ophthalmically to rabbits, was active[MC0222].

Mutagenic activity. Ethanol/water (1:1) extract of the dried flower head, at a concentration of 100.0 microliters/plate on agar plate, was active on *Salmonella typhimurium* TA100. The preparation contained *Matricaria chamomilla*, *Acorus calamus*, *Mentha piperita*, *Artemisia absinthium*, *Thymus vulgaris*, and *Foeniculum vulgare*. Metabolic activation was required to obtain positive results[MC0269]. Hot water extract of the flower, at a concentration of 12.5 mg of the dry plant material/disc on agar plate, was active on *Salmonella typhimurium* TA100. Histidine was removed from the extract prior to testing. Metabolic activation had no effect on the results[MC0243]. Infusion of the flower, on agar plate at a concentration of 50.0 mg/plate, was active on *Salmonella typhimurium* TA98 vs 2-Amino-3,7,8-trimethylimidazo[4,5,F] quinoxaline-,2-Amino-3,4,7,8-tetramethyl3H-imidazo-[4,5-F]quinooxaline-, 3-Amino-1-methyl-5H-pyrido [4,3-B]indole- and 3-Amino-1,4-dimethyl-5H-pyrid[4,3-B]indole(TRP-P-1)-induced mutagenesis. Metabolic activation was required to obtain positive results[MC0180].

Ovulation inhibition. Ethanol (40%) extract of the dried flower, administered orally to rats at a dose of 1.6 ml/kg, was inactive[MC0225].

Phagocytosis rate increased. Polysaccharide fraction of the dried entire plant, at a concentration of 10.0 mcg/ml, was active on polymorphonuclear leukocytes[MC0264].

Plant growth inhibition. Hot water extract of the entire plant, at a dose of 2.0 gm/liter, was active. The number of fronds of *Lemna paucicostata* >1 mm in length was 59% of the control[MC0209].

Plant root growth stimulation. Hot water extract of the entire plant, at a concentration of 2.0 gm/liter, was active. The number of *Cucumis sativus* roots >5 mm in length was 36.2 percent of control, and the root length in *Brassica rapa pervidis* was 100 percent of control[MC0209].

Prostaglandin inhibition. Essential oil, at a concentration of 37.0 micromols, was inactive[MC0205].

Protein synthesis inhibition. The dried seed, in buffer, was active, IC_{50} 14.0 mcg/ml[MC0207].

Psoriasis treatment. Ethanol (80%) extract of the dried flower, applied externally on adults, was active[MC0244].

Quinone reductase induction. Methanol extract of the freeze-dried leaf, in cell culture at a concentration of 2.1 mg/ml, was inactive on Hepatoma-mouse-ICIC7[MC0133].

Radical scavenging effect. Ethanol/water (1:1) extract of the dried entire plant, at a concentration of 5.0 mcg/ml, was equivocal vs superoxide anion. The result was estimated by the neotetrazolium method [MC0171]. Flavonoid fraction of the dried flower was active on human neutrophils. Determination was by chemiluminescence assay[MC0169].

Receptor binding (benzodiazepine) decreased. Methanol extract of the dried flower was active. Inhibition of RO 5-4868 binding to the rat adrenal gland membrane, flunitrazepan binding to the rat cerebellar membranes and muscimol binding to GABA receptors in cortical synaptic membranes were observed[MC0190].

Receptor binding (chloride) activity. The dried flower, at a concentration of 2.0 mcg/ml, was active[MC0173].

Receptor binding (glycine) activity. The dried flower, at a concentration of 2.0 mcg/ml, was active[MC0173].

Serotonin antagonist activity. Flavonoid fraction of the dried flower, assayed in anaphylaxis models in guinea pigs, was active[MC0169].

Smooth muscle relaxant activity. The essential oil, at a concentration of 100.0 ppm, was active on rat small intestine. There was a decrease in tone and peristalsis[MC0130]. The essential oil was active on

guinea pig ileum and trachea, ED_{50} 10.5 mg/liter and 55.0 mg/liter, respectively[MC0268].

Sunscreen effect. Ethanol (95%) extract of the dried flower, at a concentration of 10.0%, produced weak activity (SPF 2)[MC0191].

Teratogenic activity. Ethanol (40%) extract of the dried flower, administered orally to pregnant rabbits at a dose of 1.6 ml/kg, was inactive[MC0225].

Toxic effect. Ethanol (40%) extract of the dried flower, administered orally to rats of both sexes at a dose of 1.6 ml/kg, was inactive. Daily dosing for 13 weeks with diluted commercial preparations that also contained a yeast hydrolsate was done. There was no effect on hemoglobin, RBC, packed cell volume, mean corpuscle volume, mean corpuscle hemoglobin concentration, total and differential WBC, serum GPT, blood glucose, BUN, bilirubin, total protein albumin, Na^+, K^+, or cholesterol. Urine samples were normal (microscopic, chemical, cell counts). Histology after sacrifice of animals showed no pathology of the brain, pituitary, eye, salivary gland, cervical lymph node, thyroid, tongue, aorta, heart, thymus, lungs, sternal bone or marrow, esophagus, stomach, duodenum, jejunum, ileum, large intestine, spleen, mesenteric lymph node, pancreas, kidneys, adrenals, bladder, gonads, prostate, seminal vesicles, uterus, skin, mammary glands, nerve, voluntary muscle or liver. Weights of the liver, kidneys, adrenals, heart, brain, prostate and uterus were normal[MC0225].

Toxicity assessment. Ethanol (30%) extract of the flower, administered orally to mice of both sexes, produced LD_{50} 25.0 ml/kg. The LD_{50} of 30% ethanol was 42 ml/kg[MC0222]. Ethanol (80%) extract of the dried flower, administered intraperitoneally to rats, produced LD_{50} >4000 mg/kg[MC0204].

UV absorbent effect. Ethanol (95%) extract of the dried flower, at a concentration of 40.0%, produced weak activity. Maximum absorption was at 295 nm[MC0191].

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16 Morinda citrifolia

L.

Common Names

Ach	India	Nhau	Vietnam
Achi	Fiji	Nho	Vietnam
Achu	India	Nhor prey	Vietnam
Ainshi	India	Nhor thom	Vietnam
Al	India	Noko	Papua-New Guinea
Anino	Philippines	Noni	Guyana
Awl tree	Thailand	Noni	Hawaii
Bartundi	India	Nono	Cook Islands
Bengkudu	Indonesia	Nono	Rarotonga
Bo-aal	India	Nonu	Tonga
Dilo-K	India	Nuna	India
Hag apple	Nicaragua	Oko	Papua-New Guinea
Ice leaf	Nicaragua	Pain killer	Guyana
Indian mulberry	Hawaii	Pain killer	Virgin Islands
Indian mulberry	Indonesia	Patje	Indonesia
Indian mulberry	Thailand	Pemi	Bougainville
Kattatogaru	India	Pindra	India
Kura	Thailand	Riro	Bougainville
Maddi	India	Surangi	India
Mannanatti	India	Tagase	India
Mengkudu	Brunei	Te non	Bougainville
Minamaram	India	Togaru	India
Morinda	Fiji	Ura	Rotuma
Mwagum wagum	Papua	Yeiawa harachan	Nicaragua
Nhau nui	Vietnam	Yo	Thailand

BOTANICAL DESCRIPTION

A small tree of the RUBIACEAE family that grows to about 3–6 m tall, with a straight trunk. The leaves are glossy, membranous, broadly elliptical, bright green and glabrous. Petioles stout, 1.5–2 cm long, stipules connate or distinct, 10–12 mm long, apex entire or 2–3 lobed. The flowers are white and in dense ovoid to globose heads, peduncles 10–30 mm long; calyx a

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truncate rim; corolla white, 5-lobed, the tube greenish white, 7-9 mm long, the lobes oblong-deltate, 7 mm long; stamens 5, scarcely exserted; style about 15 mm long. Syncarp yellowish white, fleshy, 5–10 cm long and 3–4 cm in diameter, soft and foetid when ripe. Seeds have a distinct air chamber.

ORIGIN AND DISTRIBUTION

Native from southeastern Asia to Australia. It is now distributed throughout the tropics.

TRADITIONAL MEDICINAL USES

Bougainville. Hot water extract of the leaf is taken orally for dysentery[MC0152]. Hot water extract of the bark is taken orally during child birth to induce labor[MC0152,MC0142].

Brunei. Decoction of the root is taken orally to regulate menstruation. The leaf extract is taken orally for enlarged spleen, and the fruit is used for tooth decay[MC0135].

Cook Islands. Water extract of the dried root is used externally as a treatment for stonefish stings. Water extract of the dried fruit is used for urinary tract ailments and abdominal swellings. Crushed fruits of *Thespesia populnea* and *Morinda citrolia*, grated root of *Piper methysticum* and the leaf of *Cordia subcordata* are used in the remedy[MC0156].

East Indies. Hot water extract of the leaf is taken orally for amenorrhea[MC0161].

Fiji. The fresh leaf is warmed and covered with oil, then used as a poultice for broken bones and sprains. Infusion of the dried bark is taken orally for urinary disorders[MC0157].

Hawaii. The fresh fruit is taken orally for arthritis, diabetes, to treat breast cancer and as a food[MC0131]. Water extract of the fruit is taken orally for asthma[MC0127]. Decoction of the leaf is taken orally to induce abortion[MC0141]. The dried fruit is used for healing broken bones and for deep cuts and bruises[MC0134].

India. Decoction of the dried root is taken orally as a cathartic and febrifuge[MC0113]. The baked fruit is taken orally as an emmenagogue[MC0102,A00115]. The leaf is used for wound healing[MC0113]. Hot water extract of the dried fruit is taken orally as an emmenagogue[MC0158].

Indonesia. The fruit is used as an emmenagogue[MC0103].

Malaysia. The dried fruit and leaf are taken orally as an abortifacient[MC0155].

Papua-New Guinea. Dried leaf juice is taken orally for stomachache[MC0111]. The fresh leaf is used topically to treat leprosy sores[MC0124]. Fresh root juice is taken orally to treat malarial fevers[MC0118].

Philippines. The fruit is taken orally as an emmenagogue[MC0104].

Rarotonga. The dried leaf, in combination with other plants, is taken orally to treat gonorrhea. Fresh bark juice, in combination with *Calophyllum inophylum*, is taken orally for diabetes. Fresh root juice is used topically to treat external cancerous swellings[MC0124].

Rotuma. Infusion of the fresh root is used for insect sting and inflammation. The fresh leaf is used topically for burns. The infusion is taken orally for fever and hemorrhage. Infusion of the fresh fruit is taken orally for tuberculosis, seizures, fever, viral infection, as a tonic and for depression. The fresh flower is used for eye inflammation[MC0121].

Samoa. Juice of the dried flower is administered ophthalmically for irritated, red eyes or sore eyes. The powdered dried bark is administered orally to infants for diarrhea. The decoction of the dried bark is taken orally for stomach complaints and cough; the infusion is taken orally for worms and stomach afflictions. Water extract of the dried fruit is taken orally for fever, tuberculosis, vomiting, and opthalmically for eye complaints. The infusion, in combination with the leaf of *Boerhavia difusa* L., is taken orally for diarrhea. For intestinal worms, the infusion, in combination with the root of *Polypodium powelii*, is taken orally. The dried leaf is used externally for chest cold in infants[MC0133]. Hot water extract

of the fresh leaf is taken orally, twice daily, for severe malarial fevers[MC0118].

Tahiti. The fresh fruit is used for treating stonefish stings. The fruit is applied to the affected area[MC0156].

Thailand. The dried fruit is taken orally as a cardiotonic, for fainting and as a central nervous system stimulant[MC0149]. The hot water extract is taken orally as an antipyretic[MC0163]. The fresh leaf is eaten as a food[MC0132].

Tonga. Decoction of the dried leaf, in combination with *Pometia pinnata*, is used to expel the afterbirth. Infusion of the dried leaf, in combination with *Guettarda speciosa* and *Pometia pinnata*, is used for menorrhagia, postpartum discharge, secondary amenorrhea, and vaginal bleeding. For infertility, infusion of the dried leaf of *Alphitonia zizyphoides* and *Morinda citrifolia* is taken orally daily by the couple. For childbirth, infusion of the dried leaf, in combination with *Hibiscus tiliaceus* and *Melochia* species are used to facilitate delivery (it is thought to make the uterus slippery). To treat vaginal bleeding, infusion of *Vigna marina*, *Nephrolepis hirsutala* and *Morinda citrifolia* is taken orally. To treat severe bleeding in early pregnancy, infusion of the dried leaf of *Garcina sessilis*, *Vigna marina* and *Morinda citrifolia* is taken orally. For the syndrome locally known as "Kahi" which affects the gastrointestinal and genitourinary systems and causes lower back pain, infusion of the dried leaf of *Garcina sessilis*, *Morinda citrifolia* and *Evodia hortensis* is taken orally. For dysuria, infusion of the dried leaves of *Cymbopogon coloratus*, *Garcinia sessilis*, *Canavalia maritima* and *Morinda citrifolia* is taken orally twice daily. *Capsicum frutescens*, *Trema amboinensis* and *Zingiber zerumbet* may also be used in the preparation. For severe bleeding during early pregnancy, infusion of the dried leaves of *Glochidion concolor*, *Vigna marina*, *Cocos nucifera*, *Morinda citrifolia*, *Evodia hortensis*, and *Premna taitensis*, with lemon juice, is taken orally. For the induration of the breast associated with redness, cataplasm of the leaves of *Glochidion concolor*, *Morinda citrifolia*, and *Evodia hortensis* is applied until the lesion dries up, followed by cataplasm of the leaves of *Ficus obliqua* and *Syzygium cornocarpum*. If the breast is swollen the infusion is taken orally[MC0154].

US Virgin Islands. The fruit is taken orally for heart troubles[MC0160].

Vietnam. Leaf extract is taken orally as an emmenagogue[MC0105].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Acacetin-7-0-beta-D-glucopyranoside: Fl [MC0145]
Alizarin: Bk[MC0107]
Alizarin, alpha-methoxy: Rt Bk[MC0110], Bk[MC0107]
Anthraquinone, 1-5-6-trihydroxy: Pl[MC0116]
Anthraquinone, 2-hydroxy-1-methoxy-7-methyl: Rt[MC0114]
Anthraquinone, 3-5-6-trihydroxy-2-methyl: Pl 160[MC0144]
Anthraquinone, 3-5-6-trihydroxy-2-methyl 6-beta-primeveroside: Pl 155[MC0144]
Anthraquinone, 6-8-dimethoxy-3-methyl 1-0-beta-D-rhamnosyl-glucoside: Fl[MC0139]
Anthraquinone, 7-hydroxy-8-methoxy-2-methyl: Rt 300[MC0112]
Anthraquinones: Pl 0.25%[MC0119], Call Tiss[MC0115]
Apigenin, 5-7-dimethyl 4'-0-beta-D-galactopyranoside: Fl[MC0145]
Asperuloside: Fr 0.048%[MC0146], Lf 0.158%[MC0146]
Asperulosidic acid, deacetyl: Fr 33.3[MC0146]
Caproic acid: Fr[MC0150]
Caprylic acid: Fr[MC0150]
Carotene, beta: Bk 8.6, Lf 124[MC0130]
Damnacanthal: Rt[MC0125,MC0122]
Damnacanthal,nor: Pl[MC0116], Rt[MC0122]
Gentisic acid: Lf[MC0108]
Glucose: Fr Pu[MC0150]
Lucidin: Pl 600[MC0144]
Lucidin, 5-6-dihydroxy: Pl 109[MC0144]
Lucidin, 5-6-dihydroxy 3-beta-primeveroside: Pl 227[MC0144]
Lucidin-3-beta-primeveroside: Pl 749[MC0144]
Lucidin-omega-ethyl ether: Pl[MC0116]

Monotropen: Lf 0.158%[MC0146]
Morindin: Rt Bk[MC0110]
Morindone: Pl 146[MC0144], Heartwood 50[MC0113]
Morindone, 3-hydroxy: Pl 309[MC0144]
Morindone, 3-hydroxy 6-beta-primeveroside: Pl 58.2[MC0144]
Morindone-6-beta-primeveroside: Pl 709[MC0144]
Octanoic acid: Fr[MC0129]
Physcion: Heartwood 38[MC0113]
Physcion-8-0-[(alph-L-arabinopyranosyl91-6)]-beta-D-galactopyranoside: Heartwood 75[MC0113]
Ruberythric acid: Bk[MC0107]
Rubiadin: Pl 127[MC0144,MC0116]
Rubiadin, mono-ethoxy: Bk[MC0107]
Rubiadin, mono-methoxy: Rt Bk[MC0110]
Sitosterol, beta: Lf[MC0151], Pl 455[MC0144]
Ursolic acid: Lf[MC0151]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Analgesic activity. Ethanol/water (1:1) extract of the aerial part, administered intraperitoneally to mice at a dose of 0.375 mg/kg, was inactive vs tail pressure method[MC0159]. Lyophilized water extract of the decorticated root, administered intraperitoneally to mice at a dose of 800.0 mg/kg, was active vs acetic acid-induced writhing and the hot plate method. The effect was antagonized by naloxone[MC0147].

Antiascariasis activity. Ethanol (95%) extract of the leaf was active on earthworm. There was paralysis in 18 and death of 50 % in 18 hours[MC0117].

Antibacterial activity. Acetonitrile extract of the dried fruit, at a concentration of 100 mcg/ml on agar plate, was inactive on *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Streptococcus pyrogenes*[MC0136]. Ethanol (95%) extract of the dried leaf, at a concentration of 2-3 mcg/ml on agar plate, was inactive on *Staphylococcus albus*, *Bacillus subtilis*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*[MC0126]. Ethanol (95%) extract of the dried root bark, at a concentration of 2-3 mcg/plate on agar plate, was active on *Bacillus subtilis* and *Staphylococcus albus*, and inactive on *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Ethanol (95%) extract of the dried stembark, at a concentration of 2-3 mcg/plate, was active on *Staphylococcus albus*, inactive on *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* and produced weak activity on *Bacillus subtilis*[MC0126]. Ethanol/water (1:1) extract of the aerial part, at a concentration of >25.0 mcg/ml on agar plate, was inactive on *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhosa*, *Staphylococcus aureus*, and *Agrobacterium tumefacien*[MC0159].

Anticonvulsant activity. Ethanol/water (1:1) extract of the aerial part, administered intraperitoneally to mice at a dose of 0.375 mg/kg, was inactive vs electroshock-induced convulsions[MC0159].

Antifungal activity. Ethanol/water (1:1) extract of the aerial part, at a concentration of >25.0 mcg/ml on agar plate, was inactive on *Microsporum canis*, *Trichophyton mentagrophytes*, and *Aspergillus niger*[MC0159].

Antiinflammatory activity. Ethanol/water (1:1) extract of the aerial part, administered orally to male rats at a dose of 0.375 mg/kg, was inactive vs carrageenin-induced pedal edema. The animals were dosed 1 hour before carrageenin injections[MC0159].

Antispasmodic activity. Ethanol/water (1:1) extract of the aerial part was inactive on guinea pig ileum vs ACh- and histamine-induced spasms[MC0159].

Antitumor activity. The ethanol-insoluble fraction of the dried fruit juice, administered intraperitoneally to mice at a dose of 500.0 mcg/animal, was active on Sarcoma 180 (ASC) and CA-Lewis lung[MC0148]. Fresh fruit juice, administered intraperitoneally to mice at a dose of 15.0 mg animal, produced strong activity on CA-LLC, 119% ILS. A dose of 12.0 mg/animal was active on CA-LLC, 40% ILS[MC0131]. Methanol extract of the fresh leaf, at a concentration of 200.0 mg/ml in cell culture, produced strong

activity on Raji cells vs EBV activation induced by HPA (40 mg/ml). A dose of 20.0 mcg/ml was also active vs teleocidin-induced EBV activation[MC0138]. Methanol/water (1:1) extracts of the flower and the leaf, administered intraperitoneally to rats at a dose of 1.0 gm/kg, were inactive on sarcoma (Yoshida ASC)[MC0100].

Antiviral activity. Water extract of the dried fruit, in cell culture, was inactive on HIV-I virus, IC_{50} >250 mcg/ml[MC0136].

Antiyeast activity. Ethanol/water (1:1) extract of the aerial part, at a concentration of >25.0 mcg/ml on agar plate, was inactive on *Candida albicans* and *Cryptococcus neoformans*[MC0159].

Cell morphological alteration. Chloroform, water, methanol and hexane extracts of the dried root, in cell culture, were inactive on NRK cells. The compound induced normal morphology and fibronectin expression in K-Ras-transformed cells of given type[MC0125].

CNS effect. The fresh fruit, administered intragastrically to mice at a dose of 1.0 gm/kg, was inactive. When administered intraperitoneally, the dose produced weak activity[MC0120].

Cytotoxic activity. Methanol extract of the fresh leaf, at a concentration of 20.0 mcg/ml in cell culture, was inactive on Raji cells[MC0138]. Water extract of the dried fruit, in cell culture, was inactive on MT-4 cells, ED_{50} >250 mcg/ml[MC0136].

Diuretic activity. Ethanol/water (1:1) extract of the aerial part, administered intraperitoneally to male rats at a dose of 0.185 mg/kg, was inactive on saline-loaded animals. Urine was collected for 4 hours after treatment[MC0159].

Histaminergic effect. Ethanol/water (1:1) extract of the dried fruit, at a concentration of 0.001 gm/ml, was active on guinea pig ileum[MC0163].

Hypoglycemic activity. Ethanol/water (1:1) extract of the aerial part, administered orally to rats at a dose of 250.0 mg/kg, was inactive. Less than 30% drop in blood sugar level was observed[MC0159].

Hypotensive activity. The dried fruit and leaf, administered intravenously to rats at a dose of 0.1 ml/animal, were inactive[MC0155]. Ethanol/water (1:1) extract of the dried fruit, administered intravenously to dogs at variable dosage levels, was inactive[MC0163]. Quinone fraction of the dried root, administered intravenously to dogs, was inactive[MC0109].

Hypothermic activity. Ethanol/water (1:1) extract of the aerial part, administered intraperitoneally to mice at a dose of 0.375 mg/kg, was inactive[MC0159].

Insecticide activity. The fresh fruit pulp was active on *Drosophilia mauritana*, *Drosophilia melanogaster*, and *Drosophilia simulans*[MC0129].

Interleukin-1 formation stimulation. The dried root, in combination with extract from *Ostrea* species, *Pachyma hoeleni* fruit body and the alkaloid fraction of *Panax ginseng*, administered intraperitoneally to mice at a dose of 100.0 mg/animal daily for 7 days, was active[MC0128]. The ethanol-insoluble fraction of the dried fruit juice, at a concentration of 0.1 mg/ml in cell culture, was active on mononuclear leukocytes[MC0137].

Interleukin-4 formation stimulation. The dried root, in combination with extract from *Ostrea* species, *Pachyma hoeleni* fruit body and the alkaloid fraction of *Panax ginseng*, administered intraperitoneally to mice at a dose of 100.0 mg/animal daily for 7 days, was active[MC0128].

Nitric oxide synthesis stimulation. Ethanol-insoluble fraction of the dried fruit juice, at a concentration of 1.25 mg/ml in cell culture, was active on macrophages. The effect of interferon-gamma was enhanced[MC0137].

Reverse transcriptase inhibition. Methanol extract of the dried fruit and stem, at a concentration of 200.0 mcg/ml, was equivocal; 5% inhibition was produced vs HIV-1 reverse transcriptase[MC0148].

Semen coagulation. Ethanol/water (1:1) extract of the aerial part, at a concentration of 2.0%, was inactive on the rat semen[MC0159].

Smooth muscle stimulant activity. Ethanol/water (1:1) extract of the dried fruit, at a concentration of 0.001 gm/ml, was active on guinea pig ileum[MC0163].

Spasmolytic activity. The fresh fruit, at a concentration of 2.0 gm/ml, was inactive on guinea pig ileum vs electrical stimulation[MC0120].

Spermicidal effect. Ethanol/water (1:1) extract of the aerial part was inactive on rat sperm[MC0159].

Toxic effect. Ethanol/water (1:1) extract of the dried fruit, administered by gastric intubation and subcutaneously to mice at a dose of 10.0 gm/kg (expressed as dry weight of the fruit), was inactive[MC0149].

Toxicity assessment. Ethanol/water (1:1) extract of the aerial part, administered intraperitoneally to mice, produced LD_{50} 0.75 gm/kg[MC0159]. Methanol/water (1:1) extract of the flower and of the leaf, administered intraperitoneally to male mice, produced LD_{50} >1.0 gm/kg[MC0100].

Tranquilizing effect. Water extract of the decorticated root, administered intraperitoneally to mice at a dose of 1.6 gm/kg, was active. Sleep was induced with co-administration of subhypnotic dose of pentobarbital[MC0147].

Tumor necrosing factor release stimulation. The ethanol-insoluble fraction of the dried fruit juice, at a concentration of 0.1 mg/ml in cell culture, was active on mononuclear leukocytes[MC0137].

Uterine stimulant effect. The dried fruit and leaf, at a concentration of 0.3 ml, inactive on the pregnant rat uterus[MC0155].

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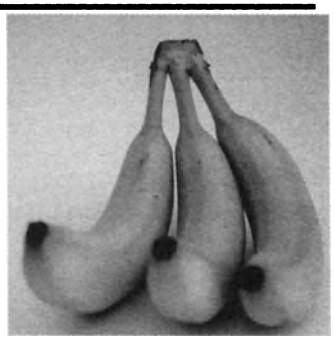
17 Musa sapientum

L.



Common Names

Adam's apple	Iran	Kela	India
Adam's fig	Iran	Keli	India
Baalehannu	India	Kluai tai	Thailand
Banana matenten	Haiti	Kluai	Thailand
Banana	Bahamas	Laek	Thailand
Banana	China	Langbodo	Nigeria
Banana	Guyana	Ma-li-ong	Thailand
Banana	Japan	Mouz	Iran
Banana	Philippines	Ogede wewe	Nigeria
Banana	USA	Ogede	Iran
Banana	West Indies	Pisang	Indonesia
Cau	Indonesia	Platana	Mexico
Chek	Thailand	Sakui	Thailand
Isu opego	Nigeria	Vala	India
Kadalam	India	Vazhaippazhan	India
Kadalamu	India	Vudi dina	Fiji
Kadali	India	Vudi	Fiji
Kala	India	Ya-khai	Thailand

BOTANICAL DESCRIPTION

The banana is a herbaceous perennial of the MUSACEAE family that grows to 5–9 m in height. It has a tuberous subterranean rhizome, from which the leaves emerge. The lower part of the leaves is folded within each other producing a 'false stem' from which the long, narrow blades protrude and spread out. In the center of the folded leaf-sheats, a growing point forms from the top of the rhizome, grows up and emerges as an overhanging inflorescence with a succession of reddish brown bracts. The bracts unfold from the base to the tip and fall off. Within the lower 1–12 bracts arise 14–18 female flowers in double rows. These develop into fruits without having to be fertilized, a process known as parthenocarpy. The next few bracts contained bisexual flowers that are rich in nectar but do not develop any further. In the upper bracts only male flowers are formed.

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

ORIGIN AND DISTRIBUTION

The banana originates in the Indomalayan area. By hybridization and domestication, the banana has spread thoughout the tropics.

TRADITIONAL MEDICINAL USES

Bangladesh. The juice of the inflorescence rachis is taken orally for bloody dysentery[MP0127].

Brazil. Ash from the dried leaf is used in the chewing the leaves of *Erythroxyum* species[MP0145]. Hot water extract of the fresh leaf is taken orally to treat hypertension or to induce diuresis[MP0177].

Cook Islands. The juice of the fresh stem is used externally for shingles[MP0174].

Fiji. The boiled fruit is eaten for acute dysentery. For burns, the ash of the dried leaf is mixed with coconut oil and applied. The immature leaf is applied as a dressing for burns and blisters. The fresh sap is taken orally for sterility in males[MP0178].

French Guiana. The flower is taken orally as an emmenagogue[MP0100]. The pericarp of the unripe fruit is taken orally as an abortive[MP0105].

Ghana. The dried inflorescence and peduncle are ground, then added to charcoal and used as a dentifrice[MP0165].

Guinea-Bissau. The flower is taken orally as an emmenagogue[MP0101].

Hawaii. Water extract of the root is taken orally for asthma[MP0135].

India. Hot water extract of the dried flower, fruit and root is taken orally for diabetes[MP0110]. The dried flower, together with the dried fruit of *Coccinia indica* L. (Voigt), is taken orally by females to prevent conception[MP0142]. Hot water extract of the root is taken orally as an anthelminitic, aphrodisiac, laxative and tonic[MP0195]. The dried root is taken orally for its antifertility properties and as an anthelmintic[MP0151]. The extract of the boiled inflorescence is used as a bath for headache and rheumatism[MP0157]. The fresh fruit is eaten as a treatment for peptic and duodenal ulcers[MP0168]. The fresh plant juice is taken first thing in the morning, at a dose of half a cup daily for 7 days and then regularly for diabetes[MP0164]. The juice of the rhizome is diluted, sweetened with sugar and taken orally to dissolve urinary stones[MP0128]. The exudate from the rhizome is taken orally for peptic ulcers[MP0157]. The fresh root juice is taken orally by females, at a dose of 250 ml after the menstrual period to prevent conception[MP0163,MP0188]. The juice of the unripe fruit is taken orally daily in the morning for stomach ulcers[MP0157]. The dried unripe fruit is taken orally for diabetes and ulcers[MP0133]. The leaf ash is mixed with honey and taken orally to treat cough[MP0141].

Indonesia. Water extract of the sap is taken orally to prevent postpartum hemorrhage[MP0166].

Malawi. Hot water extract of the dried root is taken orally to prevent premature labor[MP0173].

Nigeria. A decoction made from the dried leaf and those of *Carica papaya* is taken orally to treat general body infections. Only a small quantity should be given to children. The ashes of burnt fruit peel, stem and leaf are used externally as dusting powders for ulcers. The fresh sap is taken with food to treat diarrhea. The sap of the fresh inflorescence is used as a drop to treat earache. Water extract of the dried root is used as an enema[MP0123].

Philippines. The juice of the flower is mixed with curd and taken orally for dysmenorrhea and menorrhagia[MP0100].

Rarotonga. The sap of the fresh stem is applied to cuts and skin infections[MP0122].

Tanzania. Hot water extract of the unripe fresh fruit is taken orally to treat increased heartbeat and nervousness[MP0180].

Venda. Decoction of the dried fruit is taken orally for chest pain[MP0170].

West Indies. Hot water extract of the green fruit peel is taken orally for hypertension[MP0162].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Abscisis acid-1-4-trans-diol: Fr Pu[MP0146]
Alanine: Lf [MP0149]
Arabinitol, 2-carboxy: Lf 5 nmol/gm[MP0140]
Asparatic acid: Lf[MP0149]
Arginine: Lf[MP0149]
Banana lectin ban-lec-1: Fr[MP0114]
Banlec 1: Fr[MP0155]
Benzaldehyde,3-4-dihydroxy: Fr peel[MP0108]
Benzopyrene,3-4: Fr peel[MP0119]
Butan-1-ol,3-methyl: Fr[MP0118]
Campesterol: Stalk, Fr Pu, Rh, Lf, Fr peel[MP0152]
Cholest-20-en-3-one,9-19-cyclo,4-alpha-14-alpha-dimethyl: Fl[MP0161]
Cholesta-8-25(27)-dien-3-beta-ol,24-(R)-4-alpha-14-alpha-24-trimethyl: Fl 40[MP0167]
Citroltadienol: Fr Pu[MP0113]
Cycloartanol,24-methylene, palmitate: Fr peel[MP0107]
Cycloartanol,24-methylene: Fl[MP0161], Fr peel, Stalk, Rh[MP0152]
Cycloartenol: Fr peel, Stalk, Fr Pu, Rh[MP0152]
Cycloaudenol,31-nor: Fl[MP0112]
Cycloeucalenol: Fl[MP0161], Fr peel, Stalk, Pu, Lf, Rh[MP0152]
Cyclolaudenol,3-alpha-31-nor: Fl[MP0112]
Cyclolaudenone,31-nor: Fl[MP0167]
Daucosterol: Fr peel 0.1%[MP0113]
Delphinidin: Fr[MP0104]
Dopamine: Fr Pu 22.0-48.0 mcg/gm, Fr peel 210-720 mcg/gm[MP0120]
Elaidic acid: Fr Pu[MP0113]
Emenolone: Lf[MP0116]
Flavan-3(R)-4(R)-diol,trans-2-3-cis-3-4, 4-hydroxy, (2S),(-): Sd 250[MP0115]
Flavan-3(S)-4(R)-diol,Cis-2-3-trans-3-4, 4-7-dihydroxy, (2S),(-): Sd 1000[MP0115]
Flavan-3(S)-4(R)-diol,cis-2-3-trans-3-4,(2S),(-): Sd 500[MP0115]
Flavan-3(S)-4(R)-diol,trans-2-3-cis-3-4, 4-7-dihydroxy, (2S),(-): Sd 200[MP0115]
Glutamic acid: Lf[MP0149]
Glycerol, phosphatidyl: Lf, Fr peel, Fr Pu[MP0148]
Glycerol, sulfoquinovosyl-diacyl: Lf, Fr peel, Fr Pu[MP0148]
Glycine: Lf[MP0149]
Heptan-2-one: Fr[MP0118]
Hexan-1-ol: Fr[MP0118]
Histidine: : Lf[MP0149]
Iarenolone: Lf[MP0116]
Lauric acid: Fr Pu[MP0113]
Leucine,iso: Lf[MP0149]
Leucine: Lf[MP0149]
Linoleic acid: Fr Pu[MP0113]
Linolenic acid: Fr Pu[MP0113]
Lopenol,24-ethyl: Fr Pu[MP0113]
Lysine: Lf[MP0149]
Melatonin: Fr 46.6 ng/100 gm[MP0138]
Methionine: Lf[MP0149]
Mevalonic acid: Fr 2, Fr peel 0.5[MP0196]
Myristic acid: Fr Pu[MP0113]
Norepinephrine: Fr Pu 1.4-5.8 mcg/gm, Fr peel 27.0-81.0 mcg/gm[MP0120]
Oleic acid: Fr Pu[MP0113]
Palmitic acid: Fr Pu[MP0113]
Pentan-2-one: Fr[MP0118]
Phenylalanine: Lf[MP0149]
Phosphorylase, alpha-glucan: Fr peel[MP0117]
Proline: Lf[MP0149]
Protein: Fr peel[MP0117]
Salsolinol: Fr Pu 1.0-40.0 mcg/gm, Fr peel 0.1-260.0 mcg/gm[MP0120]
Serine: Lf[MP0149]
Sitoindoside I: Fr[MP0168]
Sitoindoside II: Fr[MP0168]
Sitoindosterol I: Fr Pu 58[MP0113]
Sitoindosterol II: Fr Pu 14[MP0113]
Sitoindosterol III: Fr Pu 64.0[MP0113]
Sitosterol, beta, myo-inosityl-beta-D-glucoside: Fr Pu 220[MP0113]
Sitosterol, beta, gentiobioside: Fr Pu 260[MP0113]
Sitosterol, beta: Fr peel, Stalk, Rh[MP0152], Fl[MP0167], Lf[MP0152], Fr Pu[MP0113]
Stigmasterol: Fr Pu[MP0113], Fl[MP0161], Fr peel Stalk, Rh, Lf[MP0152]
Syringic acid: Lf[MP0147]
Threonine: Lf[MP0149]
Tryptamine, 5-hydroxy: Fr[MP0111]
Tryptamine: Fr 29[MP0143]
Tryptophan: Lf[MP0149]
Tyrosine: Lf[MP0149]
Valine: Lf[MP0149]
Vanillic acid: Lf[MP0147]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Allergenic activity. The fresh fruit, taken orally, was active. Coincidental allergy to latex, chestnut, and/or banana was found

in 8 patients[MP0129] and coincidental allergy to latex, chestnut, and banana was found on 3 patients[MP0130]. The powdered fresh fruit, taken orally by adults, was active. Patients with latex allergy that had symptoms caused by banana showed positive skin test and specific IgE test results. Cross-reacting IgE antibodies were confirmed by several inhibition techniques[MP0134].

Anthelmintic activity. Water extract of the root, at a concentration of 1:50, was active on *Haemonchus contortus*[MP0195].

Antiallergenic activity. Water extract of the dried fruit, in cell culture at a concentration of 100.0 microliters/ml, was inactive on LEUK-RBL 2H3 vs biotinylated anti-DNP IgE/avidin-induced beta-hexosaminidase release[MP0139].

Antibacterial activity. Benzene extract of the dried root, on agar plate, was active on *Bacillus subtilis*, *Escherichia coli*, *Staphylococcus albus*, *Staphylococcus aureus*, and *Streptococcus hemolyticus*; inactive on *Pseudomonas pyocyanae* and produced weak activity on *Klebsiella aerogenes* and *Pseudomonas aeruginosa*. The ethanol (95%) extract was active on *Bacillus subtilis*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa*, and *Streptococcus hemolyticus* and produced weak activity on *Escherichia coli*, *Pseudomonas pyocyanae*, *Staphylococcus albus*, and *Staphylococcus aureus*. The hexane extract was active on *Escherichia coli*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa*, *Pseudomonas pyocyanae*, and *Staphylococcus albus*, and produced weak activity on *Bacillus subtilis*, *Staphylococcus aureus*, and *Streptococcus hemolyticus*[MP0151]. Chloroform and hexane extracts of the fresh fruit, on agar plate at a concentration of 0.2 ml/well, were inactive, and the methanol extract was active on *Bacillus cereus*, *Bacillus coagulans*, *Bacillus stearothermophilus*, and *Clostridium sporogenes*. Water extract of the concentrated puree, on agar plate at a concentration of 0.2 ml/well, was active on *Bacillus cereus*, *Bacillus coagulans*, *Bacillus stearothermophilus*, and *Clostridium sporogenes*. Water extract of the fresh fruit pulp, on agar plate at a concentration of 0.2 ml/well, was inactive on *Bacillus cereus*, *Bacillus coagulans*, *Bacillus stearothermophilus*, and *Clostridium sporogenes*[MP0153]. Water extract of the dried leaf, on agar plate at a concentration of 10.0 mg/ml, was inactive on *Corynebacterium diphtheriae* and *Streptococcus viridans*, and produced weak activity on *Diplococcus pneumoniae*, *Staphylococcus aureus*, and *Streptococcus pyogenes*[MP0160]. The leaf, used externally as dressing for skin lesions on patients with Stevens-Johnson syndrome, was effective. The leaf does not stick to the skin and appears to decrease the incidence of secondary infection[MP0137].

Antifungal activity. Benzene extract of the dried root, on agar plate, was active on *Aspergillus flavus*, *Aspergillus niger*, *Fusarium oxysporum*, and *Geotrichum candidum*. The ethanol (95%) extract was inactive on *Aspergillus flavus*, *Fusarium oxysporum*, and *Geotrichum candidum*. The hexane extract was inactive on *Aspergillus niger*, *Fusarium oxysporum* and *Geotrichum candidum*, and produced weak activity on *Aspergillus flavus*[MP0151]. Ethanol/water (50%) extract of the leaf was active on *Rhizoctonia solani*. Mycelial inhibition was 43.50%[MP0193]. The leaf essential oil, on agar plate, produced weak activity on *Fusarium oxysporum*[MP0172].

Antihemolytic activity. Water extract of the dried plant was active on red blood cells[MP0194].

Antihyperglycemic activity. Water extract of the dried flower, fruit and root, administered orally to rabbits at a dose of 10.0 mg/kg, produced a drop in blood sugar of 15 mg relative to placebo-treated controls[MP0110]. The fiber of dried ripened fruit and the dried unripened fruit, in the ration of rats at a dose of 25.0% of the diet, were inactive vs cholesterol-loaded animals, results significant at $p < 0.01$ level[MP0176]. The unripe dried fruit pulp, administered intragastrically to

rabbits at a concentration of 1.5 gm/kg, was inactive vs alloxan-induced hyperglycemia[MP0133].

Antihyperlipemic activity. The fiber of dried ripened fruit, in the ration of rats at a dose of 25.0% of the diet, was inactive vs cholesterol-loaded animals[MP0176].

Antihypertensive activity. Dried fruit, administered intragastrically to rats, was active vs desoxycorticosterone-induced hypertension. The effect was seen in animals given the fruit before and during hypertension induction or only 7 days after induction began[MP0159]. The fruit pulp, administered intragastrically to rats at a dose of 50.0 gm/animal, was active. Daily dosing inhibited deoxycorticosterone-induced hypertension[MP0132].

Antimycobacterial activity. The fruit juice, on agar plate, produced weak activity on *Mycobacterium tuberculosis*, MIC <1:40[MP0103].

Antisecretory activity. Ethanol/water (1:1) extract of the dried fruit, administered by gastric intubation to rats at a dose of 22.5 mg/kg, was active vs aspirin-induced ulcers. The extract was not as effective as cimetidine, PGE_2 or 5-HT[MP0169]. Ethanol/water (1:1) extract of the dried fruit, administered by gastric intubation to rats at a dose of 22.5 mg/kg, was effective but not as a effective as cimetidine, PGE_2 or 5-HT vs aspirin-induced ulcers[MP0169].

Antithiamine activity. The fresh fruit was active. The activity was heat-stable[MP0171].

Antithyroid activity. The fruit, taken orally by adults at a dose of 1263 gm/person, was inactive[MP0197].

Antiulcer activity. Acetone, butanol and chloroform extracts of the dried fruit were inactive. The ethanol (95%) extract was active and the ethanol/water (1:1) extract, administered by gastric intubation and intraperitoneally to rats at a dose of 22.5 mg, was active vs aspirin-induced ulcers, results significant at p <0.01 level. The fruit, in the ration of rats at a dose of 5.0 gm/animal administered before or after aspirin treatment, was active vs aspirin-induced ulcers. Results significant at p <0.001 level[MP0169]. Chromatographic fraction of the peeled fruit, administered by gastric intubation to rats at a dose of 30.0 mg/kg, was active. The fraction tested as prepared by sephadex G-50 and LH-20. The methanol extract at variable dosages, was active[MP0168]. The green fruit pulp, administered intragastrically to male rats at a concentration of 0.65 gm/animal given in a single dose before the ulcer inducer, was active vs ethanol- and indomethacin-induced ulcers[MP0131]. The powdered shade-dried fruit, administered by gastric intubation to guinea pigs at a dose of 0.5 gm/kg for 3 days, was active vs histamine-induced ulcers. Results significant at p <0.01 level. The dose was active on rats vs aspirin-, cysteamine- and indomethacin-induced, and Shay ulcers. Dosing for 7 days was active vs phenylbutazone-induced ulcers[MP0183]. The powdered dried fruit pulp, administered by gastric intubation to rats at a dose of 0.5 gm/kg for 3 days, was active, results significant at p <0.01 level[MP0182]. The powdered shade-dried fruit, administered intragastrically to rats at a dose of 0.5 gm/kg for 3 days, enhanced gastric mucosal resistance[MP0191].

Antiyeast activity. Water extract of the dried root, on agar plate, was active on *Candida albicans* using the hole-plate diffusion method, and in broth culture using test-tube dilution method. The methyl chloride extract, on agar plate, was inactive using the hole-plate diffusion method, and active in broth culture using the test-tube dilution method. The methanol extract, on agar plate, was inactive using the hole-plate diffusion method, and in broth culture using the test-tube dilution method. The petroleum ether extract, on agar plate, was active using the hole-plate diffusion method, and in

broth culture using the test-tube dilution method[MP0179].

Beta-glucuronidase inhibition. Neutral detergent extract of the dried stem, in the ration of rats at a concentration of 7.0% of the diet, was active. Beta-glucuronidase activity in the mucosa of the small intestine, colon, and cecum decreased[MP0125].

Cardiac depressant activity. Chromatographic fraction of the dried entire plant was active on the heart of the frog[MP0109].

Catecholamine-releasing effect. The fruit, in the ration of rats for 6 days, increased urinary secretion of catecholamines and indolamines[MP0181].

Cholesterol absorption inhibition. The fiber of the dried ripened fruit and the dried unripe fruit, in the ration of rabbits at a dose of 2.0 gm/animal, were inactive and active, respectively, vs cholesterol-loaded animals[MP0176].

Cholesterol inhibition. Fiber of the unripe dried fruit, in the ration of rats at a dose of 25% of the diet, was active[MP0176].

Chronotrophic effect (negative). Ethanol/water (1:1) extract of the fresh leaf, administered by gastric intubation to rats at a dose of 40.0 ml/kg, was active[MP0178].

Contracting effect. The lyophilized extract of the stem, at a concentration of 10.0 mg/ml, was active on the diaphragm. The effect was enhanced by low Ca^{++} levels and nifedipine[MP0156].

Cysteine proteinase inhibition. Buffered ripe fruit was active vs ficin activity, and inactive vs bromelain activity. The buffered fresh unripe fruit was active vs papain, ficin and bromelain activities[MP0192].

Cytotoxic activity. Ethanol/water (1:1) extract of the leaf, in cell culture, was inactive on CA-9KB, ED_{50} >20.0 mcg/ml[MP0102].

Dermatitis improvement. The leaf, used externally as a dressing for skin lesions on patients with Stevens-Johnson syndrome, was effective. The leaf does not stick to the skin and appears to decrease the incidence of secondary infection[MP0137].

Desmutagenic activity. Aqueous high speed supernatant of the fresh unripe fruit juice, on agar plate at a concentration of 0.5 ml/plate, was inactive on *Salmonella typhimurium* TA98 vs mutagenicity of L-tryptophane pyrolysis products. The assay was done in the presence of S9 mix[MP0185]. The fresh fruit homogenate, on agar plate at a concentration of 100.0 microliters/disc, was active on *Salmonella typhimurium* TA100 and TA98 vs 1,4-dinitro-2-methyl pyrole mutagenesis[MP0184]. The fresh fruit juice, at a concentration of 0.5 ml/plate, was active on *Salmonella typhimurium* TA98[MP0186].

Diuretic activity. Ethanol/water (1:1) extract of the fresh leaf, administered intragastrically to rats at a dose of 40.0 ml/kg, was active. Five parts of the fresh plant material in 100 parts of ethanol/water was used[MP0198].

DNA stimulation. The powdered shade-dried fruit, administered by gastric intubation to rats at a dose of 0.5 gm/kg, was active on the stomach vs aspirin-induced ulcers, results significant at $p < 0.001$ level[MP0183].

Fructose diphosphatase inhibition and stimulation. The fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was inactive. Fiber-free fruit was used as control[MP0154].

Gastric antisecretory activity. The powdered shade-dried fruit, administered by gastric intubation to rats at a dose of 0.5 gm/kg for 3 days, was inactive[MP0182].

Gastric secretory stimulation. The fruit juice, taken orally by adults, was active [MP0106]. The powdered shade-dried fruit, administered by gastric intubation to rats at a dose of 0.5 gm/kg for 3 days, was inactive[MP0182].

Glucose absorption inhibition. The fiber of the ripe dried fruit and the unripe dried fruit, in the ration of rabbits at a dose of 2.0

gm/animal, were inactive and active, respectively, vs cholesterol-loaded animals[MP0176].

Glucose-1-phosphatase uridyl transferase stimulation. The fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Glucose-6-phosphatase stimulation. Fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Glusose-6-phosphate dehydrogenase stimulation. Fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Glycogen content increased. Fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Glycogen synthetase stimulation. Fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Glycosaminoglycan synthesis stimulation. Detergent neutral extract of the dried unripe fruit, in the ration of rats at variable dosages, was active. The concentrations of aortic glycosaminoglycans in rats fed cholesterol free and cholesterol containing diets decreased[MP0124].

Hexokinase inhibition. Fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Hypoglycemic activity. Ethanol (100%) and chloroform extracts of the dried entire plant, administered intragastrically to rabbits at a dose of 0.5 gm/animal, and the juice at a dose of 10.0 ml/kg, were active[MP0109]. The fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154]. The dried fruit pulp, administered intragastrically to rabbits at a concentration of 1.5 gm/kg, was active[MP0133].

Hypotensive activity. Ethanol/water (1:1) extract of the fresh leaf, administered intragastrically to rats at a dose of 40.0 ml/kg, produced weak activity[MP0178].

Larvicidal activity. Water extract of the dried rhizome, at a concentration of 0.03 gm/ml, was inactive on *Culex quinquefasciatus*[MP0150].

Neuromuscular blocking activity. Aqueous high-speed supernatant of the fresh trunk juice, at a concentration of 5–8 mg/ml, was active on the biventer-cervicis muscle of the chicken. The effect was reversed by calcium, but increased by neostigmine. A concentration of 3–5 mg/ml was active on the phrenic nerve diaphragm of the mouse vs alpha-bungarotoxin or hemicholium-induced blockage of neurotransmission. A concentration of 3.0 mg/ml was active on the phrenic nerve-diaphragm of mice vs K^+-induced contractions[MP0175].

Nutritional value. The fresh fruit was taken by 3 ileostomy patients at a dose of 200.0 gm/person. The patients were involved in a study of starch breakdown in the small intestine. Up to 90% of the starch was found in ileal effluvium indicating that banana starch granules are largely indigestible. Starch content varies from 3 to 37 percent depending on ripeness[MP0126].

Peroxidase activity. The fresh fruit juice, at a concentration of 0.5 ml, produced weak activity[MP0186].

Phosphoglucomutase inhibition. Fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Pyruvate kinase inhibition. Fruit fiber, in the ration of rats at a concentration of 25% of the diet for 30 days, was active. Fiber-free fruit was used as control[MP0154].

Serotonin releasing effect. The powdered shade-dried fruit, administered by gastric

intubation to rats at a dose of 0.5 gm/kg for 3 days, was active. The effect was seen in the gastric mucosa, but not the brain, results significant at p <0.001 level[MP0182].

Skeletal muscle stimulant activity. Lyophilized extract of the stem, at a concentration of 4.0 mg/ml, was active on the diaphragm vs KCl- and electrically-induced contractions. The effect was Ca^{++} dependent and was not inhibited by tetrodotoxin. Manganese abolished the effect. Aqueous high-speed supernatant, at a concentration of 1.0 mg/ml, was active on the biventer-cervicis of the chicken and on the phrenic nerve diaphragm of the mouse vs alpha-bungarotoxin or hemicholium-induced blockage of neurotransmission[MP0175].

Smooth muscle stimulant activity. Chromatographic fraction of the dried entire plant was inactive on the rat intestine[MP0109].

Sodium content increase. The fruit pulp, administered intragastrically to rats at a dose of 50.0 gm/animal, was active. Daily dosing enhanced salt consumption in deoxycorticosterone-hypertensive animals. Ritanserin partially antagonized the effect[MP0132].

Toxicity assessment. Ethanol/water (1:1) extract of the leaf, administered intraperitoneally to mice, produced LD_{50} of 1.0 gm/kg[MP0102].

Uterine stimulant activity. Chromatographic fraction of the dried entire plant was inactive on a rat uterus[MP0109]. Water extract of the dried root, at a concentration of 0.1 ml, was inactive on the guinea pig uterus[MP0173].

WBC-Macrophage stimulation. Water extract of the freeze-dried fruit, at a concentration of 2.0 mg/ml, was inactive on macrophages. Nitrite formation was used as an index of the macrophage stimulating activity. The powdered shade-dried fruit, administered by gastric intubation to rats at a dose of 0.5 gm/kg for 3 days, was inactive[MP0182].

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18 Myristica fragrans

Houtt.

Common Names

Besbasa	Morocco	Muskat	Yugoslavia
Chan thet	Thailand	Muskatnusz	Germany
Chan	Thailand	Nuez moscada	Mexico
Dorg-chan	Thailand	Nuez moscada	Nicaragua
Goz buwwa	Egypt	Nuez moscada	Peru
Goz it-tib	Egypt	Nutmeg mace	Trinidad
Guzt s-serq	Morocco	Nutmeg	Brazil
Guzt t-tib	Morocco	Nutmeg	Guyana
Jaiphal	Fiji	Nutmeg	East Indies
Jaiphal	Nepal	Nutmeg	Europe
Jatiphal	India	Nutmeg	Grenada
Kerosin	Nicaragua	Nutmeg	Jamaica
Luk-chat-tet	Thailand	Nutmeg	Japan
Mace	Japan	Nutmeg	Nepal
Mace	USA	Nutmeg	Puerto Rico
Memoscada	Nicaragua	Nutmeg	USA
Misgadu	Nicaragua	Nutmeg	West Indies
Miskad	Guadeloupe	Nux moschata	USA
Miskad	Trinidad	Querosin	Nicaragua
Miskad	West Indies	Roudoukou	China
Muscade	Guadeloupe	Sadikka	India
Muscade	Trinidad	S-Sibisa	Morocco
Muscade	West Indies	Wasasashi	Japan
Muscade	Yugoslavia		

BOTANICAL DESCRIPTION

An evergreen tree of the MYRISTICACEAE family. The tree grows to about 30 m high with an undivided trunk. The leaves are alternate, dark green, entire-margined, sharp-edged, short-petioled, ovate-elliptical, leathery and up to 8 cm long. The bark is smooth greyish brown and the young branches are green. Male and female flowers are borne on separate trees, although there are male trees with female flowers and fruits. Male trees produce small white flowers in the axils

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of leaves. The inflorescence of the female trees are composed of 1 to 3 flowers with a white, bell-shaped perianth and a 1-celled ovary ending in a 2-lobed stigma. The ovary develops into a light yellow fleshy fruit, almost round, acuminate at the stem end, 3 to 6 cm long and 2.5 to 5 cm thick. The fruit ripens 7 to 10 months after flowering. When ripened, the fleshy part bursts open and exposes the bright red aril which surrounds the dark brown seed. Within the aril, the seed kernel is covered in a hard brown testis, which shows the lattice-like marks of the aril. The aril loses its red color as it dries, becoming brownish yellow and hardening to a horny consistency. The aril is used as a spice known as mace. The seed is dried to produce the nutmeg.

ORIGIN AND DISTRIBUTION

The nutmeg is native in the Moluccas and the Banda Islands, in the hot, wet climate of the tropical rainforest. It is now commonly cultivated in China, India and the West Indies.

TRADITIONAL MEDICINAL USES

Afghanistan. The seed is taken orally as a stimulant[MF0172].

Africa. The seeds are eaten as an aphrodisiac[MF0109].

Brazil. Hot water extract of the dried seed is taken orally to treat hypertension or to induce diuresis[MF0246].

Egypt. The seeds are eaten as a sexual stimulant[MF0210].

England. The seeds are taken orally as an emmenagogue[MF0115] and abortifacient. The hot water extract is taken orally as an antispasmodic and sedative[MF0259].

Fiji. A paste made from the dried fruit and cow's milk is used externally for pimples and eczema[MF0246].

Germany. The seed is taken orally for menorrhagic pains[MF0112], and as an abortifacient[MF0113].

Guadeloupe. Wine infusion of the seed is taken orally for abdominal pains during menstruation[MF0231].

India. Decoctions of the dried flower and fruit are taken orally for diarrhea[MF0169]. Water extract of the dried kernel is taken orally for diarrhea[MF0166] and the kerosene extract has been claimed to have ecbolic properties[MF0265]. The fresh leaf, in a mixture containing *Vitex negundo* (leaf 250 gm), *Myristica fragrans* (leaf 20 gm), *Mimosa pudica* (leaf 10 gm), *Asparagus gonocladus* (leaf 5 gm), *Cucumis melo* (seed 10 gm), and *Styrax offincinalis* (fruit 20 gm), is evaporated to dryness with 5 liters of cow's milk, and the residue is mixed with twice its weight in sugar and 1.0 kg of ghee (milk fat) and taken orally in 25 gm quantities daily to produce sterility[MF0216]. Hot water extract of the seed is taken orally as a hallucinogen[MF0162]. The seed is taken orally as an aphrodisiac (prescribed by Mahometan Doctors). Hot water extract of the plant is taken orally as a tonic, digestive, and it is claimed to have narcotic properties[MF0100].

Jamaica. The powdered dried fruit is taken orally by women during labor[MF0108].

Malaysia. The seed is taken orally to restore lost virility in the male[MF0110]; it has also been reported as an abortive[MF0134].

Mexico. Hot water extract of the dried kernel is taken as a tea for gastrointestinal troubles[MF0242]. The seed is taken orally as an abortifacient[MF0163].

Morocco. The seed is taken orally as an aphrodisiac and abortifacient. It is administered as a rectal suppository as an anti-hemorrhoidal[MF0266].

Nepal. The kernel is fried with butter and taken orally for diarrhea in children[MF0267].

Nicaragua. Decoction of the dried fruit is taken orally to aid in digestion[MF0268]. The seed is taken orally for abdominal pain, diarrhea, fever and vomiting[MF0269].

Singapore. Hot water extract of the dried leaf is taken orally to treat high blood pressure[MF0215].

Thailand. Hot water extract of the aril is taken orally as an antipyretic[MF0264].

Trinidad. Hot water extract of the seed is taken orally for complications after giving birth[MF0160]. The aril, boiled with mauby bark and anise seeds and sweetened, is taken orally as an aphrodisiac[MF0258].

USA. Hot water extract of the dried kernel is taken orally for dysmenorrhea[MF0232], and as an aromatic stimulant[MF0262]. The seed is taken orally for functional changes at menopause[MF0129]. The decoction is taken orally as an abortifacient, and the hot water extract is taken to promote menstruation[MF0177].

West Indies. The hot water extract of decoction of the seed is taken orally as an antiasthmatic, for dysmenorrhea and postparum depurant. The powdered seed is taken by women during labor[MF0211].

Yemen. Hot water extract of the seed is taken orally by men as an aphrodisiac[MF0177].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Acetic acid: Sd[MF0100,MF0101]
Acetic acid propyl ester,2-(4-allyl-2,6-dimethoxy-phenoxy)-1-(3,4-methylenedioxy-phenyl): Sd[MF0244]
Acetic acid propyl ester 2-(4-allyl-2,6-dimethoxy)-1-(4-acetoxy-3-methoxy-phenyl): Sd[MF0244]
Acetic acid propyl ester 2-(4-allyl-2,6-dimethoxy)-1-(5-acetoxy-3-4-dimethoxy-phenyl): Sd[MF0244]
Austrobailagnan 7: Aril[MF0153]
Benzene,para-methyl-iso-propenyl: Aril EO 0.02%[MF0103]
Benzene,propenyl 2,4,5-trimethoxy: Sd[MF0230]
Benzofuran 2-(3,4-methylenedioxy-phenyl)-2,3-dihydro-7-methoxy-3-methyl-5-(trans-1-propenyl): Aril[MF0149]
Benzofuran 2-(3-methoxy-4,5-methylenedioxy phenyl)-2,3-dihydro-7-methoxy-3-methyl-5-(trans-1-propenyl): Aril[MF0149]
Benzofuran 2,3-dihydro 2-(3,4,5-trimethoxy phenyl)-3-methyl-5-propenyl-7-methoxy: Sd[MF0155]
Benzofuran 2,3-dihydro 2-(3,4-dimethoxy phenyl)-3-methyl-5-propenyl-7-methoxy: Sd[MF0155]
Benzofuran 2,3-dihydro 2-(3,4-methylenedioxy phenyl)-3-methyl-5-propenyl-7-methoxy: Sd[MF0155]
Benzofuran 2,3-dihydro 2-(3,5-dimethyl-5-propenyl-7-methoxy): Sd[MF0155]
Benzofuran 2,3-dihydro 2-(3-methyl-5-propenyl-7-methoxy): Sd[MF0155]
Benzofuran trans-2,3-dihydro-7-methoxy-2-(3,4-dimethoxy-phenyl)-3-methyl-5-(prop-trans-1-enyl): Aril 19.2[MF0154]
Benzofuran trans-2,3-dihydro-7-methoxy-2-(3,4-methylenedioxy-phenyl)-3-methyl-5-(prop-trans-1-enyl): Aril 18.2[MF0154]
Benzofuran trans-2,3-dihydro-7-methoxy-2-(3-methoxy-4-5-methylenedioxy-phenyl)-5-(prop-trans-1-enyl): Aril 0.20%[MF0154]
Bergamotene, alpha: EO 2.0%[MF0185]
Bisabolene, beta: EO[MF0185]
Borneol: EO[MF0185]
Borneol acetate: EO 0.9%[MF0102]
Borneol (+): Sd EO[MF0101]
Butan-1-ol 2,3-dimethyl-1,4-bis-(3,4-methylenedioxy phenyl): Aril 6[MF0154]
Cadinene, delta: EO[MF0185]
Caffeic acid: Aril 16[MF0223]
Camphene: Aril EO 0.5%[MF0103], Sd EO 0.2-0.4%[MF0261], Lf EO[MF0175]
Camphor: Sd EO 3.4%[MF0259]
Car-3-ene: Sd EO 2.4%[MF0261]
Caryophgyllene: EO[MF0185]
Caryophyllene, beta: Aril EO 0.08%[MF0103]
Catechin,epi (-): Sd[MF0236]
Cerotic acid: Sd[MF0100]
Cineol: Lf EO[MF0175]
Cineol, 1,8: Sd EO 2.7-3.2%[MF0159]
Cironellol: Sd EO[MF0136]
Citronellol acetate: EO[MF0185]
Copaene: Sd EO 0.3%[MF0203], EO 0.8%[MF0159]
Copaene, alpha: EO 0.3%[MF0185]
Coumaric acid, para: Aril 16, Kernel 7[MF0223]
Cresol,meta 6-tert butyl: Aril 32.1[MF0149]
Cubebene, alpha: EO 1.0%[MF0185]
Cyanidin: Sd[MF0236]
Cymen-8-ol, para: EO[MF0185]
Cymene, para: Aril EO 0.9%[MF0103], Sd EO 1.6-4.3%[MF0135], Lf[MF0175]
Dec-4-en-1-ol 3-methyl acetate: EO[MF0185]
Dec-4-en-1-ol 3-methyl: EO[MF0185]

Delphidin: Sd[MF0236]
Diisoeugenol dehydro: Aril[MF0149]
Diisoeugenol dehydro 5-methoxy: Aril[MF0149]
Elemicin: Aril 0.28%[MF0149], Sd EO 1.3-2.1%[MF0203,MF0259]
Elemicin, iso cis: Sd EO[MF0136]
Elemicin, iso trans: Sd EO 0.1%[MF0259]
Eugenol: Sd EO 0.2-3.8%[MF0259]
Eugenol, 5-methoxy: EO[MF0185]
Eugenol, dehydro diiso: Aril[MF0244]
Eugenol, dehydro diiso (DL): Aril[MF0271]
Eugenol, dehydro diiso acetyl: Aril[MF0244]
Eugenol, iso-trans: EO[MF0185]
Eugenol, iso: Aril EO 0.1%[MF0103], Sd EO 0.2%[MF0259],
Eugenol iso, dehydro: Sd[MF0138]
Eugenol iso, methyl ether: Aril[MF0149]
Eugenol iso, methyl ether trans: EO[MF0185]
Eugenol iso, trans: EO[MF0185]
Eugenol, iso: Sd[MF0178]
Farnesene, alpha: EO 4.0%[MF0185]
Fenchyl alcohol: EO[MF0185]
Formic acid: SD EO[MF0101]
Fragransin A-2: Aril[MF0152]
Fragransin B-1: Aril[MF0152]
Fragransin B-2: Aril[MF0152]
Fragransin B-3: Aril[MF0152]
Fragransin C-1: Aril[MF0152]
Fragransin C-2: Aril[MF0152]
Fragransin C-2-A: Aril[MF0152]
Fragransin C-3-A: Aril[MF0152]
Fragransin C-3-B: Aril[MF0152]
Fragransin D-2: Aril[MF0153]
Fragransin D-3: Aril[MF0153]
Fragransin E-1: Aril[MF0153]
Fragransol A: Aril 9.6[MF0154,MF0153]
Fragransol B: Aril[MF0153]
Fragransol C: Aril 48.1[MF0154]
Fragransol D: Aril 5.7[MF0154]
Fragransol D-1: Aril[MF0153]
Gentisic acid: Lf[MF0133]
Geraniol: Aril EO 0.1%[MF0103], Sd EO 0.0-11.9%[MF0135]
Geraniol acetate: EO[MF0159,MF0185]
Germacrene D: EO[MF0185]
Glucose: Sd[MF0100]
Glyceryl trimyristate: EO[MF0159,MF0203]
Guaiacin: Aril 64.1[MF0149]
Guaiaretic acid, dihydro meso: Aril 94.9[MF0151]
Heptadecanoic acid: Sd EO[MF0136]
Humulene, alpha: EO 3.0%[MF0185]
Ipuranol: Sd[MF0100]
Lauric acid: Sd EO[MF0178,MF0136]
Limonene: Sd EO 2.3-11.9%[MF0135], Aril EO 9.4%[MF0103], Lf EO[MF0175]
Limonene, DL: Sd EO 2.6-8.0%[MF0102,MF0101]
Limonene, D: Sd EO 4.2%[MF0261]
Linalool: Sd EO 5.4-10.6%[MF0135], Aril EO 0.2%[MF0103]
Linalool acetate: Sd EO 1.5%[A01836]
Linalool (+): Sd EO[MF0101]
Linoleic acid: Sd[MF0155]
Lycopene: Aril[MF0206]
Macelignan: Aril 0.25%[MF0148]
Macilenic acid: Aril[MF0144]
Macilolic acid: Aril[MF0144]
Malabaricone B: Aril[MF0272]
Malabaricone C: Aril 0.1%[MF0183]
Menth-cis-2-en-1-ol, para: EO 0.1%[MF0159], Sd EO0.4%[MF0203]
Menth-trans-2-en-1-ol, para: EO[MF0185]
Menth-trans-2-ene-1,4-diol, para: EO[MF0185]
Myrcene: Sd EO 2.3-3.8%[MF0261,MF0203]
Myristic acid: Sd EO 0.3%[MF0101]
Myristicanol A: Aril 8.4[MF0154]
Myristicanol B: Aril 8.0[MF0154]
Myristicin: Sd EO 0.8-14.0%[MF0203,MF0185], Aril EO 3.8%[MF0103]
Nectandrin B: Aril[MF0152]
Nerol: EO[MF0185]
Nerol acetate EO[MF0185]
Octanoic acid: Sd EO[MF0101]
Octylphenone, 2,6-dihydroxy-9-(2,5-dihydroxyphenyl): Aril 1.82%[MF0217]
Oleic acid: Sd[MF0155]
Palmitic acid: Sd[MF0178,MF0155]
Pentadecanoic acid: Sd EO[MF0136]
Phellandrene, alpha: Sd EO 0.4-1.0%[MF0203], Lf EO[MF0175]
Phellandrene, beta: Sd EO 3.4%[MF0261], Aril EO 2.3%[MF0103]
Phenol,4-allyl 2,6-dimethoxy: Kernel[MF0230]
Phenone, octyl 2',6'-dihydroxy-9-(2,5-dihydroxyphenyl): Aril 3.27%[MF0263]
Pinene, (+): Sd EO[MF0101]
Pinene, alpha: Sd EO 12.5-26.5%[MF0203], Aril 26.7%[MF0103]
Pinene, alpha, (DL): Sd EO 3.0%[MF0102]
Pinene, beta: Sd EO 12.3-19.1%[MF0259], Aril EO 20.7%[MF0103], Lf EO[MF0175]
Pinene, beta, (+): Sd EO 68.0%[MF0102]
Piperitol, cis: Sd EO 0.1-0.6%[MF0203]

Piperitol, trans: EO[MF0185]
Prop-trans-2-en-1-ol-3-(3,4,5-trimethoxy phenyl): Aril 0.08%[MF0154]
Prop-trans-2-en-1-ol, 3-(3-methoxy-4,5-methylenedioxy phenyl):Aril 3.8[MF0154]
Propan, 2-(4-allyl-2,6-dimethoxy phenoxy)-1-(3,4,5-trimethoxy phenyl): Aril[MF0149]
Propan-1,3-diol, erythro-2-(4-allyl,2,6-dimethoxy phenyl): Aril[MF0153]
Propan-1-ol,1-(3,4,5-trimethoxy phenyl)-2-(4-allyl-2,6-dimethoxy phenyl): Fr[MF0237]
Propan-1-ol,1-(3,4,5-trimethoxy phenyl): Fr[MF0237]
Propan-1-ol,1-(3,4-dimethoxy phenyl): Fr[MF0237]
Propan-1-ol,1-(3,4-methylenedioxy phenyl)-2-(4-allyl-2,6-dimethoxy phenoxy): Sd[MF0138]
Propan-1-ol, 1-(3,5-dimethoxy-4-hydroxy phenyl)-2-(4-allyl-2,6-dimethoxy-phenoxy): Sd[MF0155]
Propan-1-ol, 1-(3-hydroxy-4-methoxy phenyl)-2-(4-allyl-2,6-dimethoxy-phenoxy): Sd[MF0155]
Propan-1-ol, 1-(3-methoxy-4-hydroxy phenyl)-2-(4-allyl-2,6-dimethoxy-phenoxy): Sd[MF0155]
Propan-1-ol, erythro-2-(4-allyl-2,6-dimethoxy-phenoxy)-1-(3,4,5-trimethoxy phenyl): Aril 115.4[MF0154]
Propan-1-ol, erythro-2-(4-allyl-2,6-dimethoxy-phenoxy)-1-(3,4-dimethoxy phenyl): Aril 141.0[MF0154]
Propan-1-ol, erythro-2-(4-allyl-2,6-dimethoxy-phenoxy)-1-(3-hydroxy-4,5-dimethoxy phenyl): Aril 32.1[MF0150]
Propan-1-ol, erythro-2-(4-allyl-2,6-dimethoxy-phenoxy)-1-(4-hydroxy-3,5-dimethoxy phenyl): Aril 256.4[MF0150]
Propan-1-ol, erythro-2-(4-allyl-2,6-dimethoxy-phenoxy)-1-(4-hydroxy-3-methoxy phenyl): Aril[MF0199]
Propan-1-ol, erythro-2-(4-allyl-2-methoxy-phenoxy)-1-(4-hydroxy-3-methoxy phenyl): Aril 32.1[MF0150]
Propan-1-ol, threo-1-(4-hydroxy-3-methoxy phenyl)-2-(2-methoxy-4-(1-trans-propenyl)-phenoxy: Aril[MF0153]
Propan-1-ol, threo-1-(4-hydroxy-3,5-dimethoxy phenyl)-2-(2-methoxy-4-(1-trans-propenyl)-phenoxy: Aril 117.5[MF0150]
Propan-1-ol, threo-2-(4-allyl-2-methoxy phenoxy)-1-(4-hydroxy-3-methoxy phenyl): Aril[MF0153]
Propan-1-ol, threo-2-(4-allyl-2,6-dimethoxy phenoxy)-1-(4-hydroxy-3-methoxy phenyl): Aril117.5[MF0150]
Propan-1-ol, threo-2-(4-allyl-2,6-dimethoxy phenoxy)-1-(4-hydroxy-3-methoxy phenyl) methyl ester: Aril[MF0149]
Propane, 2-(4-allyl-2,6-dimethoxy phenoxy)-1-(4-hydroxy-3-methoxy phenyl): Aril 53.4[MF0150]
Propane, 2-(4-allyl-2,6-dimethoxy phenyl)-1-(3,4,5-trimethoxy phenyl): Sd[MF0244]
Propane, erythro-1-(4-hydroxy-3-methoxy phenyl)-1-methoxy-2-(2-methoxy-4-(1-trans-propenyl)phenoxy): Aril[MF0153]
Propane, erythro-2-(4-allyl-2,6-dimethoxy-phenoxy)-1-(4-hydroxy-3-methoxy phenyl)-1-(4-hydroxy-3-methoxy phenyl)-1-methoxy: Aril 128.2%[MF0150]
Sabinene: Aril 14.5%[MF0103], Sd EO 15.4-50.7%[MF0203]
Sabinene, cis hydrate: Sd EO 0.2-0.7%[MF0203]
Sabinene, trans hydrate: Sd EO 0.3-0.8%[MF0203]
Safrole: Aril 0.032%[MF0149], Sd EO 0-6.0%[MF0135]
Sitosterol, beta: Sd[MF0100]
Stearic acid: Sd[MF0230,MF0178]
Terpinen-4-ol: Sd EO 3.0-19.5%[MF0259,MF0159]
Terpinen-4-ol acetate: Sd EO 0.1%[MF0203]
Terpinene, alpha: Sd EO 0.8-4.0%[MF0203]
Terpinene, gamma: Sd EO 1.9-6.8%[MF0203]
Terpineol, alpha: Aril EO 0.7%[MF0103], Sd EO 4.0-7.7%[MF0259]
Terpineol, alpha acetate: EO[MF0185]
Terpineol, beta: Sd EO[MF0136]
Terpinolene: Sd EO 0-2.6%[MF0203], Aril EO 2.1%[MF0103]
Thujene, alpha: Sd EO 3.0%[MF0261]
Tridecanoic acid: Sd[MF0178]
Trimyristin: Sd[MF0100], Aril 42.7[MF0149]
Vanillin: EO[MF0185]
Verrucosin: Aril[MF0152]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Alkylating activity reduction. Hot water extract of the dried seeds produced weak activity on the reduction of ethyl methane sulfonate toward 4-para-nitrobenzylpyridine[MF0220].

Aminopyrine-n-demethylase induction. Ether extract of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg for 7 days, was effective, results significant at p <0.02 level[MF0148].

Amtimutagenic activity. The kernel essential oil inhibited the formation of DNA adducts with aflatoxin B1 by inhibiting activation of the latter in rat liver microsomes, IC_{50} 0.032 microliters/disc[MF0168].

Analgesic activity. Methanol extract of the dried aril, administered intragastrically to mice at a dose of 0.3 gm/kg, was effective vs acetic acid-induced writhing[MF0188].

Aniline hydrase inhibition. Ether and methanol extracts of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg, were effective, results significant at p <0.01 and p <0.05 levels, respectively[MF0148].

Antiamoebic activity. The essential oil, in broth culture at a concentration of 0.5 microliters/ml, was active on *Entamoeba histolytica*[MF0173].

Antiamphetamine activity. Essential oil, administered intraperitoneally to chickens at a dose of 600 mg/kg, was active[MF0229].

Antiascariasis activity. Hot water extract of the aril, at a dose of 10.0 mg/ml, was active on *Toxacara canis*[MF0183].

Antibacterial activity. Methanol extract and phenolic fraction of the aril were active on *Streptococcus mutans*, MIC 50.0 mcg/ml and 25.0 mcg/ml, respectively[MF0149]. The aril essential oil, on agar plate, was active on *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus*, and inactive on *Pseudomonas aeruginosa*[MF0254]. The dried oleoresin, in broth culture at a concentration of 8.0 gm/liter, was inactive on *Staphylococcus aureus*[MF0257]. The seed essential oil, on agar plate, was active on *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus*, and inactive on *Pseudomonas aeruginosa*[MF0254]. Water and hot water extracts of the dried aril, on agar plate at a concentration of 0.5 ml/disc, were inactive on *Bacillus subtilis* H-17(Rec+) and M-45(Rec-)[MF0234]. Water and hot water extracts of the dried kernel and the dried kernel, on agar plate at a concentration of 0.5 ml/disc, were inactive on *Bacillus subtilis* H-17 (Rec+) and M-45 (Rec-) [MF0234]. Water extract of the dried seed, on agar plate at a concentration of 10.0%, was inactive on *Escherichia coli*[MF0247].

Anticrustacean activity. Ethanol (95%) extract of the dried seed was inactive on *Artemia salina*[MF0164].

Antidiarrheal activity. Ethanol/water (1:1) extract of the dried flower, at a dose of 300.0 mg, was effective on guinea pigs and rabbits vs *Escherichia coli* enterotoxin-induced diarrhea. Ethanol/water (1:1) and hexane extracts of the dried fruit, at a concentration of 300.0 mg, were effective on guinea pig and rabbit ileum vs *Escherichia coli* enterotoxin-induced diarrhea[MF0169]. Hot water extract of the kernel, in combination with 10 plants which form an antidiarrheal remedy in India, administered orally to mice at a dose of 100.0 mg/animal, was effective. Prior administration of the dose prevented the onset of diarrhea symptoms induced by castor oil, myrobalam and epsom salt. Prevention was partial in the case of castor oil and complete in the case of myrobalan and epsom salt[MF0221]. Ether and ethanol (95%) extracts of the dried kernel, at a concentration of 300.0 mg/unit, were effective on rabbit and guinea pig ileum vs *E. coli* enterotoxins LT and ST-induced secretory diarrhea[MF0166]. Hot water extract of the aril, administered orally to mice at a dose of 100.0 mg/animal, was active. The extract produced partial prevention of diarrhea in the case of castor oil, and complete in the case of myrobalan and epsom salt[MF0221].

Antifatigue activity. A betel quid, prepared by mixing betel nut, lime and the dried leaf of *Myristica fragrans*, taken orally by adults, was effective[MF0192].

Antifungal activity. The essential oil, on agar plate, was active on *Lentinus lepideus*, *Lenzites trabea*, *Polyporus versicolor* and several plant pathogenic fungi[MF0132]. Chloroform extract of the kernel, on agar plate at a concentration of 0.03 ml/plate, was inactive on *Cladosporium werneckii*[MF0181]. The aril essential oil, on agar plate at a concentration of 10.0%/disc, was inactive on *Geotrichum candidum*[MF0233]. The dried aril, on agar plate, was active on *Aspergillus auricomus*, *A. candidus*, *A. fischeri*, *A. flavus*, *A. fumigatus*, *A. nidulans*, *A. niger*, *A. sydowi*, *A. terreus*, *A. terricola*, *A. ustus*, and *A. versicolor*[MF0208]. The seed essential oil, on agar plate at a concentration of 10.0%/disc, was inactive on *Geotrichum candidum*[MF0233].

Antihalitosis effect. A betel quid, prepared by mixing betel nut, lime and the dried leaf of *Myristica fragrans*, taken orally by adults, was effective[MF0192].

Antiinflammatory activity. The dried aril, taken orally by human adults at variable dosage levels, was effective[MF0227]. Methanol extract of the dried aril, administered intragastrically to mice at a dose of 1.0 gm/kg, was effective vs acetic acid-induced vascular permeability[MF0188].

Antimycobacterial activity. Leaf juice, on agar plate, produced weak activity on *Mycobacterium tuberculosis*, MIC < 1:20[MF0106].

Antinematodal activity. Methanol extract of the aril, at a concentration of 1.0 mg/ml, was active on *Toxacara canis*[MF0197, MF0191]. Water extract of the kernel, at a concentration of 10.0 mg/ml, had weak activity on *Toxacara canis*. The methanol extract, at a concentration of 1.0 mg/kg, was active[MF0197].

Antioxidant activity. Ethanol (95%) extract of the aril essential oil, at a concentration of 0.02%, was effective on lard. The biological activity has been patented[MF0263]. Petroleum ether extract of the aril, at a concentration of 0.1%, produced strong activity, and the petroleum ether insoluble fraction was active. Petroleum ether extract of the seed, at a concentration of 0.1%, produced weak activity, and the insoluble fraction was active[MF0213].

Antipyretic activity. Ethanol/water (1:1) extract of the dried aril, administered by gastric intubation to rabbits at variable dosage levels, was not effective vs yeast-induced pyrexia. Ethanol/water (1:1) extract of the dried seed, administered by gastric intubation to rabbits at variable dosage levels, was not effective vs yeast-induced pyrexia[MF0264].

Antispasmodic activity. Water extract of the dried leaf, at a concentration of 0.005 ml/ml of the extract that was made with 1.0 gm of leaf/1.0 ml of water, was active on guinea pig ileum vs nicotine-induced contractions, and inactive vs ACh or histamine-induced contractions[MF0215].

Antitoxic activity. Ether extract of dried aril essential oil, administered intraperitoneally to mice at a dose of 100.0 mg/kg, was effective vs strychnine toxicity. Ether extract of the dried seed, administered intraperitoneally to mice, was inactive vs strychnine toxicity[MF0186]. The distillate, ethanol (95%), hexane and methanol extracts of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg, were effective vs strychnine mortality test. Eight of 10 animals vs 3 of 10 controls; 9 of 10 vs 3 of 10 controls; 6 of 10 vs 3 of 10 controls and 7 of 10 vs 3 of 10 controls survived[MF0252].

Antitumor activity. Water extract of the dried kernel, administered intraperitoneally to mice, was effective on sarcoma 180 (solid)[MF0165].

Antiyeast activity. Essential oil of the aril, on agar plate at a concentration of 10.0%/disc, was active on *Candida lipolytica*, *Kloeckera apiculata*, *Rhodotorula rubra*, and *Torulopsis glabrata*, and inactive on *Brettanomyces anomalus*, *Debaryomyces hansenii*, *Lodderomyces elongisporus*, *Pichia membranaefaciens*, *Saccharomyces cerevisiae*, and *Kluyveromyces fragilis*[MF0233]. The aril essential oil, on agar plate, was active on *Candida albicans*[MF0254].

The seed essential oil, on agar plate at a concentration of 10.0%/disc, was inactive on *Brettanomyces anomalus*, *Candida lipolytica*, *Debaryomyces hansenii*, *Hansenula anomala*, *Kloeckera apiculata*, *Kluyveromyces fragilis*, *Lodderomyces elongisporus*, *Metschikowia pulcherrima*, *Pichia membranaefaciens*, *Rhodotorula rubra*, *Saccharomyces cerevisiae*, and *Torulopsis glabrata*[MF0233]. The seed essential oil, on agar plate, was active on *Candida albicans*[MF0254].

Aphrodisiac activity. Ether and ethanol (95%) extracts of the dried seed, administered intraperitoneally to rats, produced no effect on social behavior, including homosexual mounting, sniffing and lying over one another[MF0218].

Aryl hydrocarbon hydroxylase induction. Powdered dried aril, administered intragastrically to mice at a dose of 2.0% of the diet for 20 days, was effective[MF0201].

Barbiturate potentiation. Ether and methanol extracts of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg, were effective, results significant at $p < 0.001$ level[MF0148]. Ether extract of the dried aril essential oil, administered intraperitoneally to mice at a dose of 100.0 mg/kg, prolonged the sleeping time induced by hexobarbital[MF0186]. The essential oil, administered intraperitoneally to male mice at a dose of 50.0 mg/kg, prolonged sleep duration by 41%[MF0207]. The distillate, ether, water, hexane and methanol extracts of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg, were effective, results significant at $p < 0.001$, 0.001, 0.05, 0.05 and 0.001 levels, respectively[MF0252].

Carcinogenesis inhibition. Dried aril, administered intragastrically to mice at a dose of 10.0 mg/day, was effective vs methylocholanthrene-induced carcinogenesis. The incidence of carcinogenesis decreased 52%[MF0196].

Chronotropic effect (positive). Ethanol/water (1:1) extract of the dried aril, administered intravenously to dogs at a dose of 0.15 gm/kg, was effective[MF0264].

Clastogenic activity. Powdered dried aril, administered intragastrically to mice at a dose of 2.0% of the diet for 30 days, was inactive on *Mucor miehei*[MF0201].

CNS depressant activity. Low boiling terpene fraction of the seed essential oil, administered intraperitoneally to male chickens at a dose of 600.0 mg/kg, produced a dose-dependent increase in the average duration of light sleep episodes in young chicks[MF0202]. The aril essential oil, administered by gastric intubation to rats at a dose of 25.0 mg/kg, was not effective. A dose of 600.0 mg/kg was equivocal[MF0226]. The dried kernel, administered by gastric intubation to monkeys at a dose of 5.0 gm/animal, was not effective[MF0180]. The essential oil, applied externally, was effective on the goldfish[MF0128]. The seed, taken orally by male adults at a dose of 5.0 gm/person, caused drowsiness for 24 hours. Coffee was given as an antidote[MF0119].

Cytochrome B-5 increase. The powdered dried aril, administered intragastrically to mice at a dose of 0.5% of the diet for 10 days, was effective[MF0201].

Cytochrome P-450 induction. Ether extract of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg, was effective, results significant at $p < 0.05$. The methanol extract was not effective[MF0148]. Powdered dried aril, administered intragastrically to mice at a dose of 1.0% of the diet for 10 days, was effective[MF0201].

Diaphorase inducing activity. Powdered dried aril, administered intragastrically to mice at a dose of 0.5% of the diet for 10 days, was effective[MF0201].

Diuretic activity. Ethanol/water (1:1) extract of the dried seed, administered intragastrically to rats at a dose of 40.0 ml/kg, was effective[MF0184].

Embryotoxic effect. The seed essential oil, administered orally to rabbits at a dose

of 400.0 mg/kg daily for 13 consecutive days, was not effective[MF0260].

Ethanol potentiation effect. The seed essential oil, administered intraperitoneally to male chickens at a dose of 200.0 mg/kg, was effective[MF0270].

Euphoriant activity. A betel quid, prepared by mixing betel nut, lime and the dried leaf of *Myristica fragrans*, taken orally by adults, was effective[MF0192]. The seed, taken by 10 male prison inmates at a dose of 18.0 gm/person, was effective[MF0130].

Glutathione-s-transferase induction. Powdered dried aril, administered intragastrically to mice at a dose of 0.5% of the diet for 10 days, was effective[MF0201]. The essential oil, administered intragastrically to mice at a dose of 30.0 mg/animal every 2 days for a total of 3 doses, was not effective on the small intestine, liver or stomach[MF0198]. The seed essential oil, administered intragastrically to mice at a dose of 30.0 mg/animal every 2 days for a total of 3 doses, was inactive on the small intestine, liver and stomach[MF0198].

GRAS status. GRAS status was approved by the United States Food and Drug Administration in 1976 (sect.582.10) as a flavoring agent[MF0157].

Hallucinogenic activity. A woman who consumed 2 ground seeds had symptoms of a warm feeling, slight nausea, sweating, dry mouth and throat, intoxicated drowsy feeling, flushed skin, rapid pulse, incoherent speech, giddiness, disturbed vision, hallucinations of faces laughing at her and monsters in bed trying to engulf her. Full recovery was indicated in 24 hours[MF0162]. An adult female who ingested approximately 18.3 gm of the seed was hospitalized until recovery 2 weeks later[MF0122]. Two college students who took approximately 14.0 gm of the dried seed each in milk were hospitalized[MF0143].

Hexobarbital hydroxylase inhibition. Ethanol (95%) and methanol extracts of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg, were effective, results significant at $p < 0.05$ levels[MF0252].

Hexobarbital hydroxylase stimulation. Ether and methanol extracts of the dried aril, administered intraperitoneally to mice at a dose of 200.0 mg/kg, were effective, results significant at $p < 0.02$ and $p < 0.05$ levels, respectively[MF0148].

Hypertensive activity. Ethanol/water (1:1) extract of the dried seed, administered by gastric intubation to rats at a dose of 40.0 ml/kg, was not effective[MF0245].

Hypotensive activity. Water extract of the dried leaf (1.0 gm of leaf/1 ml water), administered intravenously to rats at a dose of 1.2 ml/kg, was effective. The duration of action was 2 hours[MF0215].

Immunosuppressant activity. The essential oil, administered intragastrically to mice at a dose of 1.5 gm/kg, was not effective when humoral immunity was assayed in sheep erythrocyte plaque formation, and cellular immunity was assayed in survival time after *Listeria monocytogenes* infection[MF0171].

Intestinal antisecretory activity. The dried kernel, administered by gastric intubation to rats at a dose of 1.0 gm/kg, was effective[MF0240].

Larvicidal activity. The seed, at a dose of 1.0% of the diet, produced weak activity on *Callosobruchus maculatus* larvae[MF0176].

Lipoxygenase inhibition. The seed essential oil, at a concentration of 1.0 mg/ml, was inactive on the rabbit platelets[MF0250].

Liver regeneration stimulation. The aril essential oil, administered subcutaneously to partially hepatectomized male rats at a dose of 100.0 mg/animal daily for 7 days, was effective [MF0224].

Malondialdehyde inhibition. The powdered dried aril, administered intragastrically to mice at a dose of 2.0% of the diet for 10 days, was effective[MF0201].

Monoamine oxidase inhibition. One depressed and 4 schizophrenic patients were

treated with the seed at a dose of 500.0 mg/person 3 times daily for 3 weeks. Four of the 5 patients showed improvement. When administered orally to rats at a dose of 500.0 mg/kg, the seed was effective[MF0137].

Mutagenic activity. Chloroform/methanol (2:1) extract of the aril, tested on pig kidney cells (LLC-PK-1) and trophoblastic-placenta cells on agar plate, produced complete growth inhibition. The effect was the same with or without metabolic activation. Chloroform/methanol (2:1) extract of the kernel, on agar plate, produced complete growth inhibition on pig kidney-LLC-PK-1 cells and trophoblastic placenta cells. The effect was the same with or without metabolic activation, IC_{100} 10.0 mg/plate. The water extract was not effective[MF0222]. Ethanol (95%) extract of the dried seed, on agar plate at a concentration of 10.0 mg/plate, produced strong activity on *Salmonella typhimurium* TA102 and weak activity on *Salmonella typhimurium* TA98[MF0164]. The aril, at variable concentrations, and the water and hot water extracts, on agar plate at a concentration of 0.5 ml/disc, were inactive on *Bacillus subtilis* H-17(Rec+) and M-45(Rec-)[MF0234]. The oleoresin and its chromatographic fraction, on agar plate, were effective on *Salmonella typhimurium* TA100 (streptomycin dependent strain SD 1018) and *Salmonella typhimurium* TA 98 (streptomycin dependent strain SD 7823)[MF0238]. The seed essential oil, on agar plate at a concentration of 0.005%/plate, was inactive on *Saccharomyces cerevisae* D4 and *Salmonella typhimurium* TA1535, TA1537 and TA1538. The same results were observed in activation and non-activation tests[MF0212]. Water and hot water extracts of the dried kernel and the dried kernel, on agar plate at a concentration of 0.5 ml/disc, were inactive on *Bacillus subtilis* H-17 (Rec+) and M-45 (Rec-)[MF0234].

Parasympatholytic activity. Ethanol/water (1:1) extract of the dried aril, at variable concentrations, was inactive on guinea pig ileum[MF0264].

Penis erectile stimulant. The dried fruit, taken orally by adults, produced an improvement in erection, duration of coitus and postcoital satisfaction in 56 cases treated for 4 weeks[MF0256].

Pheromonal activity. Water extract of the seed was effective as sex attractant and for signaling in *Costelytra zealandica*[MF0156].

Plaque formation suppressant. Water and water/methanol (1:1) extracts of the aril were inactive, and the methanol extract was active on *Streptococcus mutans*, IC_{50} >1000 mcg/ml, >1000 mcg/ml and 20.0 mcg/ml, respectively[MF0251].

Platelet aggregation inhibition. Ethanol (95%) and petroleum ether extracts of the dried seed, at a concentration of 10.0 mcg/ml, were active in rabbits vs arachidonic acid-induced aggregation[MF0250]. The essential oil, in cell culture, was effective vs arachidonic acid-induced aggregation, IC_{50} 13.0 mcg/ml[MF0248] and 17.1 mcg/ml[MF0190]. The seed essential oil was active vs arachidonic acid-induced aggregation, IC_{50} 10.0 mcg/ml[MF0250].

Progestagenic effect. The seed, taken orally by female adults at a dose of 7.5 gm/person, was not effective in stopping excessive menstrual flow[MF0127].

Prostaglandin synthetase inhibition. Petroleum ether and chromatographic fraction of the kernel, administered orally to rats at a dose of 40.0 mg/kg twice daily for 7 days, was effective[MF0204].

Psychotropic activity. The dried kernel, taken orally by adults at a dose of 15.0 gm/person, caused emotional lability, feelings of isolation and impairment of intellectual processes[MF0180]. A betel quid, prepared by mixing betel nut, lime and the dried leaf of *Myristica fragrans*, taken orally by adults, was effective[MF0192].

Smooth muscle relaxant activity. Hot water extract of the dried seed, at a concentration of 1.0 mcg/ml, was active vs potas-

sium^{+}-induced contractions[MF0189]. The essential oil, at a concentration of 100.0 mg/liter, was not effective on guinea pig ileum, but was effective on the trachea, ED_{50} 44.0 mg/liter[MF0249].

Teratogenic activity. The seed essential oil, administered orally to pregnant rabbits at a dose of 400.0 mg/kg daily for 13 consecutive days, was inactive[MF0260].

Thromboxane B-2 synthesis inhibition. The seed essential oil, at a concentration of 100.0 mcg/ml, was active on rabbit platelets, results significant at $p < 0.05$ level[MF0250].

Toxic effect. Ethanol/water (1:1) extract of the dried root, administered by gastric intubation and subcutaneously to mice at a dose of 10.0 gm/kg, was not effective[MF0209]. The dried kernel, taken orally by adults at a dose of 15.0 gm/person, caused vasomotor instability, tachycardia, hypothermia, absence of saliva, constricted pupils, emotional lability, feelings of isolation and impairment of intellectual processes[MF0180]. The dried kernel, taken orally by adults, produced abdominal pain, vomiting, elevated urinary pH, elevated white cell count, tachycardia, hypertension, hallucinations, drowsiness, and restlessness[MF0146]. The seed, administered orally to cats at a dose of 3.3 gm/kg, caused salivation and anorexia for 2 days and the animals died 72 hours after dosing. Autopsy indicated fatty degeneration of the liver. At a dose of 5.0 gm/animal the animals were jaundiced and drowsy on, the third day, followed by coma and death[MF0121]. A pregnant woman who took 1 entire seed to induce abortion had headache, dizziness, stomachache and difficulty in breathing. Recovery was 2 days later[MF0124]. Ten hours after an adult ingested 7.5 gm of the seed, he had red swollen face, temperature of 103 degrees Fahrenheit, slight cyanosis of the nails but no other parts of the body, vomiting, dizziness and restlessness. Recovery was 5 days later[MF0125]. A male adult who ingested the seed mixed with gin was comatose[MF0120].

Toxicity assessment. Essential oil of the kernel, administered intraperitoneally to rats, produced LD_{50} 1.72 gm/kg. LD_{50} for the water extract was 0.5 gm/kg[MF0180]. When the seed essential oil was administered orally to hamsters, mice, rats, and cats, the LD_{50} were 6.0 gm/kg, 5.62 gm/kg, 2.6 gm/kg and 1.9 gm/kg, respectively[MF0259].

Tranquilizing effect. Hexane extract of the kernel, administered intraperitoneally to chickens at a dose of 2 gm/kg, was effective[MF0255].

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19 Nelumbo nucifera

Gaertn.

Common Names

Ambal	India	Lotus	Nepal
Ambuja	India	Nelum	Sri Lanka
Baino	Cambodia	Padma	India
Bhasinda	India	Pamposh	India
Bua luang	Thailand	Podum	India
Erra-tamara	India	Pankaj	India
East Indian lotus	Nepal	Plumula nelumbinis	China
Gusetsu	China	Pundarika	India
Hindu lotus	China	Renbo	China
Indian lotus	Japan	Renniku	Japan
Kamal	India	Salukid ba	India
Kalung	India	Senthamara	India
Kamal	Nepal	Soh-lapudong	India
Kamala	India	Suriyakamal	India
Kayo	Japan	Tavare-gadde	India
Lian	China	Thamara	India
Lotus	Cambodia	Upal ba	India
Lotus	India	Water lily	Guyana
Lotus	Japan	Yeon-kot	Japan

BOTANICAL DESCRIPTION

This genus of the water-lily or NYMPHACACEAE family is an aquatic herb with stout, creeping rhizome. The leaves are peltate, 60–90 cm or more in diameter, orbicular and glaucous. Petioles are very long, smooth or with small prickles. The flowers are solitary, large and white or rosy; fruit-torus is large, top-shaped, 5–10 cm in diameter, spongy, with 10–30 uniovulate carpels sunk separately in cavities on the upper side. The carpels mature into ovoid nut-like achenes.

ORIGIN AND DISTRIBUTION

N. nucifera is a native of China, Japan and possibly India. The natural distribution extends from Japan to N. E. Australia and across the Caspian Sea. It has become naturalized in eastern Asia through cultivation.

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

TRADITIONAL MEDICINAL USES

Cambodia. Hot water extract of the root is taken orally as an emmenagogue[NN0101].

China. Hot water extracts of the dried receptacle and the rhizomes are taken orally as hemostatics[NN0137]. Hot water extract of the rhizome is taken orally to expel the placenta and/or dead fetus[NN0111]. Hot water extract of the seed is taken orally for spermatorrhea[NN0112]. Decoction of the sun-dried flower is taken orally as a diuretic and aphrodisiac[NN0130].

India. Hot water extract of the dried flower is taken orally for cholera[NN0140]. Hot water extract of the rhizome is taken orally as a sedative[NN0133]. Olive oil extract of the dried fruit, in a mixture containing *Terminalia arjuna*, *Aglaia roxburghiana*, *Jasminum officinalis*, *Indogofera tinctoria*, *Tinospora cordifolia*, *Pterocarpus marsupium*, *Eclipta alba*, *Pandanus tectorius*, *Oroxylum indicum*, *Valeriana hardwickii*, *Terminalia chebula*, *Terminalia bellerica*, *Emblica officinalis*, *Punica granatum* and *Sesamum indicum*, is used externally to prevent premature graying of the hair [NN0157]. The fresh leaf is made into a paste and applied topically for leprosy[NN0132]. The dried seed is taken with rice wash orally for 7 days by females to increase fertility[NN0143].

Indo-China. Hot water extract of the rhizome is taken as a tea for menorrhagia[NN0103].

Japan. Decoctions of the dried rhizome and dried seed are taken orally as protectants against alcohol toxocity[NN0150].

Korea. Hot water extract of the dried flower is taken orally as an abortifacient[NN0141].

Malaysia. Hot water extract of the embryo is taken orally to treat spermatorrhea[NN0103].

Nepal. Hot water extract of the flower is taken orally for menorrhagia[NN0100].

Taiwan. Decoction of the dried seed is taken orally to treat diabetes mellitus[NN0117].

Thailand. Hot water extract of the dried rhizome is taken orally as an antiinflammatory agent, cardiotonic and neurotonic. Hot water extract of the dried seed is taken orally as a tonic[NN0155]. Hot water extract of the stamen is taken orally as an antipyretic. Hot water extract of the root is taken orally as an antipyretic[NN0155].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Alkanes (C12-C27): Lf EO 40.0%[NN0120]
Anonaine: Lf[NN0121]
Armepavine: Lf[NN0121]
Armepavine, (DL): Embryo 95.2[NN0147]
Armepavine, N-Nor: Lf[NN0121], Pod, Sd[NN0102]
Asimilobine: Lf 15.0%[NN0121]
Asimilobine, N-methyl: Lf[NN0121]
Coclaurine, N-methyl 4-methyl: Embryo[NN0121]
Cynaroside: Embryo[NN0105]
Ginnol: Lf[NN0110]
Hyperoside: Embryo, Torus[NN0105], Plumule[NN0131]
Kaempferol-3-0-beta-D-glucuronide: Torus[NN0105]
Liensinine: Lf[NN0104], Sd[NN0116], Plumule[NN0131], Embryo 0.85-0.94%[NN0114]
Liensinine, iso: Sd[NN0108], Embryo 125[NN0147]
Linalool: Petiole EO 12.5%[NN0120]
Lirinidine: Lf 22[NN0121]
Liriodenine: Pod, Sd[NN0102], Lf[NN0121]
Lotusine: Sd[NN0113]
Meratin: Torus[NN0105]
Neferine: Sd[NN0108], Embryo 220[NN0147], Plumule[NN0131]
Nelumbo polysaccharide: Sd 203[NN0109]
Nonadecane, N: Petiole EO 10.5%[NN0120]
Nuciferine: Lf[NN0110], Sd, Pod[NN0102]
Nuciferine, N-nor: Aer[NN0108]
Nuciferine, nor: Lf[NN0121]
Nuciferine, nor (-): Pod, Sd[NN0113]
Nuciferine, pro: Sd[NN0113]
Phytol: Lf EO 16.2%[NN0120]
Quercetin: Receptacle 99[NN0122]
Quercetin-3-0-beta-D-glucuronide: Torus[NN0105]
Quercitrin, iso: Lf[NN0134]
Roemerine: Lf[NN0121]
Rutin: Plumule[NN0131], Embryo[NN0105]
Sitosterol, beta: Sd[NN0105], Lf[NN0110]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Adrenergic receptor blocker (Alpha-2). Water extract of the dried seed produced strong activity[NN0127].

Alcohol dehydrogenase inhibition. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes after ethanol (3 g/kg) administration, was active. Measurements were made at 1 and 6 hours after administration in liver cytosol. The treatment was inactive when administered 30 minutes before or simultaneously with ethanol. Decoction of the dried seed, administered intragastrically to rats at a dose of 332.0 mg/kg 30 minutes after ethanol (3 gm/kg), was active in liver cytosol when measured at 1 and 6 hours after administration. The treatment was inactive at 1 and 6 hours after administration when administered 30 minutes before or simultaneously with ethanol[NN0150].

Aldehyde dehydrogenase inhibition. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes after ethanol (3 g/kg) administration, was active. Measurement was made 1 hour after treatment in liver cytosol. The treatment was inactive when administered 30 minutes before or simultaneously with ethanol and measured 1 and 6 hours later. When administered 30 minutes after ethanol, the decoction was inactive 6 hours after the treatment. Decoction of the dried seed, administered intragastrically to rats at a dose of 332.0 mg/kg 30 minutes after ethanol (3 gm/kg), was active when measured 1 hour after administration. The treatment was inactive when measured 6 hours after administration. When administered 30 minutes before or simultaneously with ethanol (3 gm/kg), the decoction was inactive when measured at 1 and 6 hours after administration[NN0150].

Analgesic activity. Ethanol/water (1:1) extract of the rhizome, administered intraperitoneally to mice at a dose of 0.5 mg/kg, was inactive vs tail pressure method[NN0154]. Ethanol/water (1:1) extract of the seed, administered intragastrically to mice, was inactive vs hot plate and tail clip methods[NN0151].

Angiotensin II inhibition. Water extract of the dried seed was inactive[NN0127].

Antiallergenic activity. Water extract of the fresh leaf, in cell culture at a concentration of 100.0 microliters/ml, produced weak activity on Leuk-RBL 2H3 vs biotinylated anti-DNP IgE/avidin-induced Beta-hexosaminidase release[NN0118].

Antibacterial activity. Decoction of the dried seed, on agar plate, was inactive on *Staphylococcus aureus*, MIC 125.0 mg/ml; *Bacillus cereus*, MIC 250.0 mg/ml; *Proteus vulgaris*, MIC 250.0 mg/ml; *Salmonella typhi* type 2, MIC 250.0 mg/ml; *Sarcina lutea*, MIC 250.0 mg/ml; *Bordetella bronchiseptica*, MIC 62.5 mg/ml; and *Micrococcus flavus*, MIC 62.5 mg/ml[NN0149]. Decoction of the dried stamen, on agar plate, produced weak activity on *Streptococcus mutans*, MIC 122.2 mg/ml [NN0123]. The ethanol (95%) extract of the dried stamen, on agar plate at a concentration of 100.0 mg/disc, was inactive on *Escherichia coli*, *Salmonella typhosa*, *Shigella dysenteriae*, *Staphylococcus aureus*, and *Bacillus subtilis*. The water extract, on agar plate at a concentration of 20.0 mg/disc, was active on *Staphylococcus aureus*, and inactive on *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhos*, and *Shigella dysenteriae*[NN0135]. Ethanol/water (1:1) extract of the rhizome, on agar plate at a concentration of >25.0 mcg/ml, was inactive on *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhosa*, *Staphylococcus aureus*, and *Agrobacterium tumefaciens*[NN0154].

Anticonvulsant activity. Ethanol/water (1:1) extract of the rhizome, administered intraperitoneally to mice at a dose of 0.5 mg/kg, was inactive vs electroshock-induced convulsions[NN0154].

Antiedema activity. Methanol extract of the flower, at a dose of 2.0 mg/ear, was inactive on mice vs 12-0-tetradecanoylphorbol-13-acetate-induced ear inflammation. The inhibition ratio was 0[NN0115].

Antifungal activity. Ethanol/water (1:1) extract of the rhizome, on agar plate at a

concentration of >25.0 mcg/ml, was inactive on *Microsporum canis*, *Trichophyton mentagrophytes*, and *Aspergillus niger*[NN0154].

Antihemorrhagic activity. Water extracts of the dried receptacle and the dried rhizome, administered intraperitoneally to male mice at a dose of 0.5 gm/kg, were active. Parching of the plant material increased the activity[NN0124].

Antihepatotoxic activity. Methanol extract of the dried seed, administered intraperitoneally to rats of both sexes at a dose of 300.0 mg/kg, was equivocal vs alpha-naphthylisothiocyanate induced hepatotoxicity. A dose of 100.0 mg/kg, administered subcutaneously to rats of both sexes, produced weak activity vs CCl_4-induced hepatotoxicity[NN0153].

Antihistamine activity. Ethanol/water (1:1) extract of the stamen was inactive on guinea pig's ileum[NN0155].

Antihypercholesterolemic activity. Ethanol (95%) extract of the freeze-dried leaf, administered by gastric intubation to rats at a dose of 0.16 gm/kg, was active vs cholesterol-loaded animals, results significant at $p < 0.01$ level[NN0142].

Antihyperglycemic activity. Ethanol (100%) and water extracts of the dried flower, administered intragastrically to rabbits at a dose of 1.0 gm/kg, were active vs glucose induced hyperglycemia. The effect was seen on fasting blood sugar in moderately diabetic animals. No effect was seen in severely diabetic animals. The ethanol (100%) and water extracts, administered intragastrically to rats at a dose of 1.0 gm/kg daily for 6 weeks, were active vs glucose-induced hyperglycemia[NN0128]. Ethanol (95%) and water extracts of the sun-dried flower, administered intragastrically to rabbits at a dose of 1.0 gm/kg, were active vs epinephrine-induced hyperglycemia[NN0130]. Water extract of the dried seed, administered intragastrically to mice at a dose of 1.0 gm/kg, was inactive vs streptozotocin-induced hyperglycemia. The dose was given 1 hour after streptozotocin and twice daily for 3 subsequent days. Blood glucose was 269.5 vs 236.3 mg/dl for controls[NN0129].

Antihyperlipemic activity. Ethanol (95%) extract of the freeze-dried leaf, administered by gastric intubation to rats at a dose of 0.16 gm/kg, was active vs cholesterol-loaded animals[NN0142].

Antiinflammatory activity. Ethanol/water (1:1) extract of the rhizome, administered orally to male rats at a dose of 0.5 mg/kg, was inactive vs carrageenin-induced pedal edema. The animals were dosed 1 hour before carrageenin injections[NN0154].

Antimutagenic activity. Ethanol (70%) extract of the dried root, on agar plate, was inactive on *Escherichia coli* PQ 37 by the SOS-chromotest method vs mitomycin-induced mutagenesis[NN0125].

Antinematodal activity. Water extract of the dried leaf, at variable concentrations, was inactive on *Meloidogyne incognita*[NN0139].

Antioxidant activity. Methanol extract of the fruit and the seed, at a concentration of 50.0 microliters, produced strong activity[NN0119].

Antipyretic activity. Ethanol/water (1:1) extract of the root and stamen, administered by gastric intubation to rabbits at variable dosage levels, was inactive vs yeast-induced pyrexia[NN0155]. Hot water extract of the dried flower, administered intragastrically to rats, was inactive vs pyrexia induced by subcutaneous injection of yeast[NN0107].

Antispasmodic activity. Ethanol/water (1:1) extract of the rhizome was inactive on guinea pig ileum vs histamine and ACh-induced spasms[NN0154]. Ethanol/water (1:1) extract of the root, at variable concentrations, was active on guinea pig ileum. Ethanol/water (1:1) extract of the stamen, at variable concentrations, was inactive on guinea pig ileum[NN0155].

Antiulcer activity. Hot water extract of the dried fruit, administered by gastric intubation to mice at a dose of 1.10 gm/kg, was inactive on ulcers induced by stress[NN0138].

Antiviral activity. Ethanol/water (1:1) extracts of the rhizome[NN0154] and the seed[NN0151], in cell culture at a concentration of 50.0 mcg/ml, were inactive on vaccinia virus.

Antiyeast activity. Ethanol (95%) extract of the dried stamen, on agar plate at a concentration of 100.0 mg/disc, and the water extract at a concentration of 20.0 mg/disc, were inactive on *Candida albicans*[NN0135]. Ethanol/water (1:1) extract of the rhizome, on agar plate at a concentration >25.0 mcg/ml, was inactive on *Candida albicans* and *Cryptococcus neoformans*[NN0154].

Barbiturate potentiation. Ethanol/water (1:1) extract of the rhizome, administered intraperitoneally to mice at a dose of 0.5 mg/kg, was active[NN0154].

Calcium channel blocker. Water extract of the dried seed was equivocal when assayed by displacement of either nitrendipine or diltiazem[NN0127].

Cardiotoxic activity. Ethanol/water (1:1) extract of the stamen, administered intravenously to dogs at variable dosage levels, was inactive[NN0155].

Cardiovascular activity. Ethanol/water (1:1) extract of the root, administered intravenously to dogs at variable dosage levels, markedly increased the heart rate[NN0155].

Chronotrophic effect (positive). Ethanol/water (1:1) extract of the stamen, administered intravenously to dogs at variable dosage levels, was inactive[NN0155].

Complement enzyme inhibition. Water extract of the dried seed produced strong activity[NN0127].

Cytotoxic activity. Ethanol (100%) extract of the dried fruit, in cell culture at a concentration of 0.1 ml/plate, was inactive on Hela cells[NN0106]. Water extract of the dried seed, in cell culture at a concentration of 500.0 mcg/ml, was inactive on CA-mammary microalveolar[NN0127].

Desmutagenic activity. Aqueous high speed supernatant of the fresh fruit juice (unripe), on agar plate at a concentration of 0.5 ml/plate, was inactive on *Salmonella typhimurium* TA98 in the presence of S9 mix vs mutagenicity of L-tryptophan pyrolysis product[NN0145]. Homogenate of the fresh seed, on agar plate at a concentration of 100.0 microliters/disc, was active on *Salmonella typhimurium* TA98 and TA100 vs 1,4-dinitro-2-methyl pyrrole mutagenesis[NN0144]. The fresh plant juice, on agar plate at a concentration of 0.5 ml/plate, was inactive on *Salmonella typhimurium* TA98[NN0146].

Diuretic activity. Ethanol/water (1:1) extract of the rhizome, administered intraperitoneally to saline-loaded male rats at a dose of 0.25 mg/kg, was active. Urine was collected for 4 hours posttreatment[NN0154]. Ethanol/water (1:1) extract of the seed, administered intragastrically to rats at a dose of 750.0 mg/kg, was inactive[NN0151].

Estrous cycle disruption effect. Petroleum ether extract of the dried seed, administered intraperitoneally to mice at a dose of 3.0 mg/kg, was active[NN0152].

Ethanol absorption decrease. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420 mg/kg 30 minutes after ethanol (3 gm/kg), was inactive. Decoction of the dried seed, at a dose of 3.0 gm/kg, was inactive in the rat jejunum and stomach. Intragastric administration to rats, at a dose of 332.0 mg/kg, was inactive[NN0150].

Ethanol elimination increase. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes before or simultaneously with ethanol (3 gm/kg), was active. Decoction of the dried seed, administered intragastrically to rats at a dose of 332.0 mg/kg, 30 minutes before ethanol or simultaneously with ethanol (3.0 gm/kg), was active[NN0150].

Ethanol oxidation enhanced. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes before, simultaneously with or 30 minutes after ethanol (3 gm/kg) treatment, was active, results significant at $p < 0.05$ level. Decoction of the dried root, administered intragastrically to rats at a dose of 332.0 mg/kg 30 minutes before, simultaneously with, or 30 minutes after ethanol (3 gm/kg), decreased the lactate/pyruvate ratio in blood after 1 hour[NN0150].

Glucose uptake induction. Ethanol (100%) extract of the dried flower, administered intragastrically to rats at a dose of 1.0 gm/kg daily for 6 weeks, was active. Following the treatment the animals were sacrificed and a diaphragm preparation was made. Insulin-stimulated glucose uptake was enhanced in the preparation from animals fed the extract[NN0128].

Glutamate oxaloacetate inhibition. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes before, simultaneously with or 30 minutes after ethanol (3 g/kg), was inactive. Decoction of the dried seed, administered intragastrically to rats at a dose of 332.0 mg/kg 30 minutes before, simultaneously with, or 30 minutes after ethanol (3 gm/kg), was inactive[NN0150].

Glutamate oxaloacetate stimulation. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes before, simultaneously with or 30 minutes after ethanol (3 g/kg), was inactive. Decoction of the dried seed, administered intragastrically to rats at a dose of 332.0 mg/kg 30 minutes before, simultaneously with, or 30 minutes after ethanol (3 gm/kg), was inactive[NN0150].

Glutamate pyruvate transaminase inhibition. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes before, simultaneously with or 30 minutes after ethanol (3 g/kg), was inactive. Decoction of the dried seed, administered intragastrically to rats at a dose of 332.0 mg/kg 30 minutes before, simultaneously with, or 30 minutes after ethanol (3 gm/kg), was inactive[NN0150].

Glutamate pyruvate transaminase stimulation. Decoction of the dried rhizome, administered intragastrically to rats at a dose of 420.0 mg/kg 30 minutes before, simultaneously with or 30 minutes after ethanol (3 g/kg), was inactive. Decoction of the dried seed, administered intragastrically to rats at a dose of 332.0 mg/kg 30 minutes before, simultaneously with, or 30 minutes after ethanol (3 gm/kg), was inactive[NN0150].

Hemostatic activity. Hot water extract of the dried receptacle, administered intraperitoneally to mice at a dose of 1.0 gm/kg, was active. Hot water extract of the dried rhizome, administered intraperitoneally to mice at a dose of 1.0 gm/kg, was active[NN0137].

Hypoglycemic activity. Ethanol (100%) and water extracts of the dried flower, administered intragastrically to rabbits at a dose of 1.0 gm/kg, were active. A dose of 500.0 mg/kg produced weak activity. When administered to rats at a dose of 1.0 gm/kg daily for 6 weeks, the extracts produced an acute effect[NN0128]. Ethanol/water (1:1) extract of the rhizome, administered orally to rats at a dose of 250.0 mg/kg, was inactive. Less than 30% drop in blood sugar level was indicated[NN0154].

Hypotensive activity. Ethanol/water (1:1) extract of the stamen, administered intravenously to dogs at variable dosage levels, was inactive[NN0155].

Hypothermic activity. Ethanol/water (1:1) extract of the rhizome, administered intraperitoneally to mice at a dose of 0.5 mg/kg, was inactive[NN0154].

Nematocidal activity. Decoction of the rhizome and the stamen, at a concentration of 10.0 mg/ml, were inactive on *Toxacara canis*[NN0126].

Platelet activating factor binding inhibition. Water extract of the dried seed produced weak activity[NN0127].

Semen coagulation. Ethanol/water (1:1) extract of the rhizome, at a concentration of 2.0%, was inactive on the rat semen[NN0154].

Spasmolytic activity. Ethanol/water (1:1) extract of the seed was inactive on the rat uterus[NN0151].

Spermicidal activity. Ethanol/water (1:1) extract of the rhizome was inactive on the rat sperm[NN0154].

Toxic effect. Ethanol/water (1:1) extracts of the dried root and the stamen, administered by gastric intubation and subcutaneously to mice at a dose of 10.0 gm/kg, were inactive[NN0136].

Toxicity assessment. Ethanol/water (1:1) extract of the rhizome, administered intraperitoneally to mice, produced LD_{50} 1.0 gm/kg[NN0154]. Ethanol/water (1:1) extract of the seed, administered intraperitoneally to mice, produced LD_{50} >1 gm/kg[NN0151]. Water extract of the dried receptacle, administered intraperitoneally to mice, produced LD_{50} 2.5 gm/kg[NN0122].

Tumor promotion inhibition. Ethyl acetate extract of the fresh root, in cell culture at a concentration of 200.0 mcg/ml, was active on Epstein-Barr virus vs 12-0-hexadecanoylphorbol-13-acetate-induced Epstein-Barr virus activation. The methanol extract was inactive[NN0148].

WBC macrophage stimulant. Water extract of the freeze-dried seed, at a concentration of 2.0 mcg/ml, was inactive. Nitrile formation was used as an index of the macrophage stimulating activity[NN0144].

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20 Pimpinella anisum

L.

Common Names

Anis vert	France	Badishep	India
Anis vert	Tunisia	Boucage anis	North Africa
Anisa	India	Habbat hlawa	Morocco
Anise seed	Guyana	Kuppi	India
Anise seed	Japan	Mitha-jira	India
Anise seed	Trinidad	Muhuri	India
Anise seed	West Indies	Petit anise	North Africa
Anise seed	Yugoslavia	Razianaj	Arabic countries
Anise	Argentina	Saunf Star anise	India
Anise	Colombia	Saunf	India
Anise	Guatemala	Sawonf	India
Anise	Mexico	Shombu	India
Anise	Peru	Somp	India
Anise	USA	Sop	Nepal
Anisoon	Arabic countries	Sop	India
Annesella	Italy	Sopu	India
Badian	Afghanistan	Star anise	USA
Badian	India		

BOTANICAL DESCRIPTION

An annual of the UMBELLIFERAE family. It grows to 30–60 cm high with ternately pinnate leaves. The flowers are small, white, and borne in compound umbels. The fruit is ovoid or pyriform, laterally compressed, 3–5 mm in length and 2–3 mm wide, grayish green to grayish brown with a peculiar sweet smell. The mericarp is broadly ovoid, 5-ridged with short hairs and numerous vittae.

ORIGIN AND DISTRIBUTION

This native of the eastern Mediterranean region is widely cultivated in southern and central Europe, USSR, North Africa and to a lesser extent Mexico and South America.

TRADITIONAL MEDICINAL USES

Afghanistan. Hot water extract of the fruit, together with ginger, is taken orally during the menstrual cycle to induce pregnancy[PA0202].

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Arabic countries. Hot water extract of the fruit is taken orally as an emmenagogue in Unani medicine[PA0183].

Argentina. Decoction of the dried fruit is taken orally for diarrhea and respiratory and urinary tract infections[PA0137]. Hot water extract of the seed is taken orally to facilitate childbirth and expulsion of the placenta[PA0109].

Colombia. Hot water extract of the fruit is taken orally as a galactagogue[PA0102].

Egypt. The essential oil is taken orally as an aphrodisiac[PA0107]. The essential oil of the fruit is taken orally as a galactagogue[PA0206].

Europe. Hot water extract of the dried aerial parts is used to induce milk letdown and as an aphrodisiac[PA0174]. Hot water extract of the fruit is taken orally by pregnant women to produce abortion[PA0171]. The essential oil is taken orally as a galactagogue[PA0206].

France. Hot water extract of the fruit is taken orally as a galactagogue, expectorant and antispasmodic[PA0173].

Guatemala. Decoction of the seed is taken orally for stomach pains and fever[PA0141].

Italy. Ethanol/water (1:1) extract of the seed is taken orally to treat spasms in the intestines[PA0200]. Infusion of the fruit is taken orally as a digestive and antiasthmatic[PA0133].

Malaysia. Hot water extract of the fruit is taken orally by the mother immediately after giving birth[PA0115].

Mexico. Decoction of the dried seed, in combination with *Allium cepa* and *Allium sativum*, is given to the newborn child[PA0187]. Hot water extract of the dried fruit is taken orally as an abortifacient[PA0129].

Morocco. The fruit is taken orally as an aphrodisiac, a poison antidote, for digestive difficulties and as an aperitive for aerophagie[PA0143].

North Africa. Hot water extract of the fruit is taken orally as a galactagogue[PA0201].

Peru. Hot water extract of the dried fruit is taken orally as a carminative, tonic and stimulant[PA0199].

Trinidad. The fruit, together with mauby bark and nutmeg mace, is boiled, sweetened with sugar and taken orally as an aphrodisiac[PA0205].

Tunisia. Hot water extract of the dried fruit is taken orally for stomach pain, heartburn and as a galactagogue[PA0185].

USA. Fluid extract of the fruit is taken orally to increase the secretion of milk[PA0111]. Hot water extract of the dried fruit is taken orally for nausea, flatulence, colic in infants, and as a carminative and stimulant [PA0209]. Hot water extract of the seed is taken orally for asthma and as a carminative[PA0146]. Infusion of the dried seed is taken orally for coughs[PA0181]. The dried seeds are taken orally for gastritis, flatulence, abdominal cramping, gastrointestinal disorders and dyspepsia[PA0157].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Abscisic acid: Fr 0.224[PA0169]
Anethole, cis: Fr EO[PA0147]
Anethole, trans: Lf EO[PA0179], Fr EO[PA0147]
Anethole: Fr EO 80-90%[PA0101], Sd[PA0134], Shoots[PA0153]
Anisaldehyde: Fr[PA0150], EO[PA0121]
Anisic acid, para: Fr EO[PA0147]
Anisic acid: EO[PA0163]
Anisketone: Sd EO[PA0126]
Anisyl alcohol: Fr EO[PA0147]
Anisyl ketone: Fr EO[PA0147]
Benzene, 2-hydroxy-5-methoxy-trans-propenyl 2-methyl-butyrate: Fr EO[PA0128]
Benzoic acid, 4-beta-d-glucopyranosyl-oxy: Fr 0.90%[PA0186]
Benzoquinone, 1,4: Rt, Lf, Callus tissue[PA0119]
Bergamotene, alpha, trans: Sd EO[PA0168]
Bergapten: Callus tiss 0.5%[PA0135], Fr[PA0158]
Bisabolene, beta: EO, Callus tiss[PA0148]
Caffeic acid: Fr 2060[PA0175]
Camphene: EO[PA0163]
Camphor: Fr EO[PA0147]
Carvone, dihydro acetate: Fr EO[PA0147]
Carvone: Sd EO[PA0168], Fr EO[PA0147]
Caryophyllene, beta: Fr EO[PA0147]
Chamazulene: EO[PA0163]

Choline, acetyl: Sd 64 nmol/gm[PA0154]
Choline: Sd 3950 nmol/gm[PA0154]
Cinnamaldehyde: Sd EO[PA0168]
Cinnamyl alcohol: Sd EO[PA0168]
Coumaric acid, para: Fr 737[PA0175]
Cynaroside: Fr 0.128%[PA0170]
Elemene, beta: Sd EO[PA0168]
Essential oil (*Pimpinella anisum*): Call tiss[PA0204], Sd 0.61%[PA0116], Fr 2.4-3.2%[PA0101]
Estragole: EO 81.5% [PA0164], Fr EO 4.0% [PA0147]
Eugenol, (2-methyl-butyrate), pseudo-iso epoxy: Shoot[PA0153]
Eugenol, (2-methyl-butyrate), pseudo-iso: Shoot[PA0153]
Eugenol, (2-methyl-butyryl ester), iso pseudo epoxy: Callus EO[PA0148]
Eugenol, (2-methyl-butyryl ester), iso pseudo: Fr[PA0150], Callus EO[PA0148]
Eugenol, (2-methyl-butyryl ester), iso pseudo epoxy: EO[PA0148]
Eugenol, (2-methyl-butyryl ester), iso-pseudo: EO[PA0148]
Eugenol, iso pseudo 2-mehtyl-butyrate: Fr EO[PA0151]
Eugenol, iso pseudo 2-methyl-butyrate epoxide: Fr EO[PA0151]
Eugenol, iso pseudo epoxy 2-methyl-butyrate: Sd[PA0152]
Eugenol: Fr EO[PA0147]
Fenchone: Fr EO[PA0147]
Foeniculin: Fr[PA0150]
Geijerene, pre: Rt EO 16.4%[PA0182]
Glucinol: Pl[PA0177]
Imperatorin: Lf[PA0131]
Limonene: Fr EO[PA0147]
Linalool: Fr EO[PA0147]
Luteolin: Fr 0.125%[PA0170]
Luteolin-7-O-beta-d-xyloside: Fr 0.158%[PA0170]
Myristicin: Sd[PA0208], Callus EO[PA0148]
Oleic acid: Sd 21.7%[PA0184]
Orientin, iso: Fr[PA0178]
Petroselinic acid: Sd 48.9%[PA0184]
Phellandrene: Sd EO[PA0116]
Phenyl-(DL)-2-methyl-butanoate 4-methoxy-2-(prop-trans-1-enyl): Aer 1.5%[PA0145]
Phenyl, 4-methoxy-2-(trans-1-propenyl) 2-methyl-butyrate: Sd[PA0152]
Pinene, alpha: EO[PA0163]
Plastohydroquinone 9: Rt, Lf, Callus tiss[PA0119]
Plastoquinone: Rt, Lf, Callus tiss[PA0119]
Psoralen, 5-methoxy: Fr[PA0139]
Purine, amino 6-benzyl: Callus tiss[PA0149]
Quercetin-3-O-beta-d-glucuronide: Fr[PA0178]
Quercitrin, iso: Lf[PA0207]
Rutin: Fr[PA0178]
Safrole: EO[PA0121]
Scoparone: Lf[PA0131]
Scopoletin: Lf[PA0131], Callus tiss 2.5%[PA0135]
Seselin: Lf[PA0131]
Sitosterol, beta: Callus tiss[PA0120]
Stigmasterol: Callus tiss[PA0120]
Stilbene 4,4-dimethoxy: Fr EO[PA0156]
Terpinene, alpha: EO[PA0163]
Terpineol: EO[PA0121]
Thujene, alpha: EO[PA0163]
Thymol: EO[PA0163]
Tocopherol, alpha: Callus tiss, Rt, Lf[PA0119]
Tocoquinone, alpha: Callus tiss, Rt, Lf[PA0119]
Umbelliferone: Callus tiss 0.5%[PA0135]
Vitamin K1: Callus tiss, Rt, Lf[PA0119]
Vitexin, iso: Fr[PA0178]
Xanthotoxin: Fr[PA0139,PA0158]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Absorption effects. The essential oil, administered to the abdomen of mice at a concentration of 0.25%, was inactive after 2 hours[PA0118].

Adenosine nucleotide release inhibition. The essential oil, in cell culture at a concentration of 100.0 mcg/ml, was active on aortic endothelium[PA0165].

Adenosine uptake inhibition. The essential oil, in cell culture at a concentration of 40.0 mcg/ml, was active on aortic endothelium[PA0165].

Allergenic activity. The essential oil, at a concentration of 5.0%, produced contact dermatitis in cake factory workers[PA0123].

Analgesic activity. Hot water extract of the dried seed, administered intraperitoneally to mice at a dose of 150.0 mg/kg, was active vs benzoquinone-induced writhing and the hot plate method[PA0198].

Antibacterial activity. Decoction of the dried fruit, on agar plate, was inactive on *Pseudomonas aeruginosa*[PA0137]. The ethanol (95%) extract, at a concentration of 50.0 microliters/plate, was active on *Staphylococcus aureus*[PA0140]. The water extract, at concentrations of 1.0 mg/ml[PA0122] and 50.0 microliters/plate[PA0140], was inactive on *Salmonella typhi* and *Staphylococcus aureus*, respectively. The hot water extract, at a concentration of 62.5 mg/ml, was inactive on *Escherichia coli* and *Staphylococcus aureus*[PA0136]. The fruit essential oil, on agar plate, was active on *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*,[PA0195] and *Bacillus cereus*[PA0197]. The essential oil, on agar plate, was active on *Pseudomonas aeruginosa* and *Staphylococcus aureus*, and inactive on *Bacillus cereus* and *Escherichia coli*[PA0180].

Anticonvulsant activity. Ethanol (95%) extract of the dried fruit, administered intraperitoneally to mice at a dose of 2–4 ml/kg, was active vs supramaximal electroshock-induced convulsions; produced weak activity vs corazol-induced convulsions and was inactive vs strychnine-induced convulsions[PA0106]. Water extract of the dried twig, administered intraperitoneally to mice at a dose of 0.2 ml/animal, was active vs picrotoxin-induced convulsions, results significant at $p < 0.001$ level[PA0193].

Anticrustacean activity. Ethanol (95%) extract of the dried fruit was active on *Artemia salina*, LD_{50} 145 mcg/ml[PA0130].

Antiedema activity. Methanol extract of the fruit, applied topically to the mouse at a dose of 2.0 mg/ear, was active vs 12-O-tetradecanoylphorbol-13-acetate-induced ear inflammation. The inhibition ratio was 6[PA0132].

Antifungal activity. Hot water extract of the dried fruit, at a concentration of 62.5 mg/ml, was inactive on *Aspergillus niger* [PA0136]. The fruit essential oil, on agar plate, was active on *Lentinus lepideus*, *Lenzites trabea*, and *Polyporus versicolor*[PA0112]. A concentration of 500 ppm was active on *Alternaria alternata*, *Alternaria tenuissima*, *Aspergillus awamori*, *Aspergillus fumigatus*, *Aspergillus nidulans*, *Aspergillus ochraceus*, *Aspergillus sydowi*, *Aspergillus tamarii*, *Aspergillus terreus*, *Botryodiplodia threobromae*, *Cladosporium herbarum*, *Cladosporium werneckii*, *Colletotrichum capsici*, *Curvularia lunata*, *Curvularia pallescens*, *Fusarium monoliforme*, *Fusarium oxysporum*, *Fusarium udum*, *Mucor spinescence*, *Penicillium chrysogenum*, *Penicillum citrinum*, and *Rhizopus nigricans*[PA0194]. The oil produced strong activity on *Aspergillus aegyptiacus*, *Penicillium cyclopium*, and *Trichoderma viride*[PA0197]. A concentration of 1.0 ml/plate was active on *Rhizoctonia solani* and *Sclerotinia sclerotiorum*; inactive on *Phytophthora capsici* and produced weak activity on *Fusarium moniliforme*[PA0124]. The seed essential oil, on agar plate, was active on *Aspergillus flavus*, *Aspergillus niger*, *Fusarium oxysporum*, and *Penicillium* species [PA0162]. The essential oil, on agar plate, was inactive on *Penicillium cyclopium*, *Trichoderma viride*, and *Aspergillus aegyptiacus*[PA0180].

Antihypertensive activity. Ethanol (95%) extract of the dried entire plant, in a mixture containing *Cucumis melo*, *Carum carvi*, *Zea mays*, *Foeniculum vulgare*, *Laurus nobilis*, *Prunus avium*, and *Tribulus terrestris*, was active[PA0189].

Anti-inflammatory activity. Ethyl acetate and hexane extracts of the fruit, applied topically to the mouse at a dose of 20.0 microliters/animal, were equivocal vs tetradecanoyl phorbol acetate-induced acetate phospholipid synthesis and 12-O-tetradecanoyl phorbol-13-acetate-induced ear inflammation. The methanol extract produced weak activity vs tetradecanoyl phorbol acetate-induced acetate phospholipid synthesis[PA0125].

Antimutagenic activity. Infusion of the fruit, on agar plate at a concentration of 100.0 microliters/disc, was inactive on *Salmonella typhimurium* TA100 vs ethyl methanesulfonate-induced mutagenicity. It was also active on *Salmonella typhimurium* TA98 vs

2-amino-anthracene induced mutagenicity. Metabolic activation was required for activity[PA0144].

Antinematodal activity. Water extract of the fruit, at a concentration of 10.0 mg/ml, produced weak activity on *Toxacara canis*. The methanol extract, at a concentration of 1.0 mg/ml, was active[PA0159].

Antioxidant activity. Petroleum ether extract of the fruit, at a concentration of 0.1%, was inactive, and the petroleum ether insoluble fraction produced weak activity[PA0172].

Antispasmodic activity. Ethanol (95%) extract of the dried entire plant, in a mixture containing *Cucumis melo*, *Carum carvi*, *Zea mays*, *Foeniculum vulgare*, *Laurus nobilis*, *Prunus avium*, and *Tribulus terrestris*, was active[PA0189].

Antiviral activity. Ethanol (80%) and water extracts of the dried aerial parts, in cell culture at concentrations of 6.0 and 8.0 mg/ml respectively, were active on Rinderpest virus[PA0196]. Water extract of the dried fruit, in cell culture at a concentration of 10.0%, was inactive on Herpes virus type 2, influenza virus A2 (Manheim 57), poliovirus II, and vaccinia virus[PA0188].

Antiyeast activity. The fruit essential oil, on agar plate, was active on *Candida albicans*[PA0195].

Barbiturate potentiation. Ether extract of the dried seed, administered intraperitoneally to mice at a dose of 100.0 mg/kg, was inactive[PA0155]. The essential oil, administered intraperitoneally to mice at a dose of 50.0 mg/kg, produced 93% prolongation[PA0167].

Chromosome aberration induction. The seed, together with the seed of *Cuminum cyminum*, administered intragastrically to mice at a dose of 0.1 gm/animal, produced weak activity on the sperm and bone marrow[PA0161].

Clastogenic activity. The seed, together with the seed of *Cuminum cyminum*, administered intragastrically to mice at a dose of 0.1 gm/animal, produced weak activity on bone marrow micronucleated cells[PA0161].

CNS depressant activity. The essential oil, applied externally to goldfish, was active[PA0108].

Cytotoxic activity. Ethanol (50%) extract of the fruit, in cell culture, was inactive on CA-98KB, ED_{50} >20.0 mcg/ml[PA0103].

Cytotoxic activity. Water extract of the dried fruit, in cell culture at a concentration of 10.0%, was inactive on Hela cells[PA0188].

Diuretic activity. The dried seed, administered by gastric intubation to rabbits, was active. The effect was blocked by morphine[PA0117].

Estrogenic effect. The essential oil, administered subcutaneously to ovariectomized rats at a dose of 0.1 ml/animal, produced an activity equivalent to 0.1 mcg estradiol[PA0105]. The essential oil, administered subcutaneously to ovariectomized mice, produced activity equivalent to less than 10 units/ml. When administered to immature female rats, activity equivalent to 100 units/ml was produced[PA0100]. The seed oil, administered subcutaneously to ovariectomized rats, was active[PA0114].

Expectorant activity. The essential oil, administered orally to guinea pigs at a dose of 10.0 mg/kg, was active[PA0107].

Galactagogue effect. Ethanol (95%) extract of the dried fruit, in a preparation containing *Carum carvi*, *Foeniculum vulgare*, *Anethum graveolens*, *Trigonella foenum-graecum*, and *Petroselinum crispum*, taken orally by 80 nursing mothers with low breast milk, was effective. The quantity of milk increased while taking the mixture. It had no effect on the milk content (water, fat and carbohydrate), and no toxic effect was observed in either mothers or babies[PA0191].

Glutathione-S-transferase induction. The essential oil, administered intragastrically to mice at a dose of 30.0 mg/animal every other day for a total of 3 doses, was inactive on the small intestine, liver and stomach[PA0160].

GRAS status. The seed was approved by the United States of America Food and Drug Administration in 1976 (Sect. 582.10) as a flavoring agent[PA0127].

Hypotensive activity. Ethanol (50%) extract of the fruit, administered intravenously to dogs at a dose of 50.5 mg/kg, was active[PA0103].

Hypotensive activity. Water extract of the seed, at a concentration of 10%, was active in rats. The effect was abolished by atropine[PA0154].

Immunosuppressant activity. The essential oil, administered intragastrically to mice at a dose of 0.375 gm/kg, was inactive. Humoral immunity was assayed in sheep erythrocyte plaque formation, and cellular immunity assayed in survival time after *Listeria monocytogenes* infection[PA0138].

Insecticidal activity. Acetone extract of the aerial parts was active on *Musca domestica*[PA0166]. Chloroform extract of the fresh aerial parts was active on *Aedes aegypti* and *Drosophila melanogaster*[PA0166].

Kidney stone dissolution. Ethanol (95%) extract of the dried entire plant, in a mixture containing *Cucumis melo*, *Carum carvi*, *Zea mays*, *Foeniculum vulgare*, *Laurus nobilis*, *Prunus avium*, and *Tribulus terrestris*, was taken by 300 patients with kidney and ureteral stones. Sixty-seven percent of the patients passed stones, 18% transferred and there was a decrease in volume of the stones in 11% of the patients. Ninety-eight percent of the patients reported relief from colic[PA0189].

Liver regeneration stimulation. The seed essential oil, administered subcutaneously to partially hepatectomized rats at a dose of 100.0 mg/animal daily for 7 days, was active, results significant at $p < 0.01$ level[PA0176].

Mutagenic activity. Ethanol (95%) extract of the dried fruit, on agar plate at a concentration of 10.0 mg/plate, produced weak activity on *Salmonella typhimurium* TA102[PA0130]. Ethanol (95%) extract of the dried seed, on agar plate at a concentration of 5-20 mg/plate, was active on streptomycin-dependent strain of *Salmonella typhimurium* TA98. Metabolic activation had no effect on the results[PA0192].

Nematocidal activity. Water extract of the dried fruit, in cell culture at a concentration of 10.0 mg/ml, and methanol extract, at a concentration of 1.0 mg/ml, were active on *Toxacara canis*[PA0142].

Skeletal muscle stimulant activity. Water extract of the seed, at a concentration of 10.0%, was active on the frog rectus abdominus muscle. The effect was abolished by tubocurarine[PA0154].

Smooth muscle relaxant activity. The essential oil was active on the dog small intestine[PA0203]. The essential oil, at a concentration of 100.0 mg/liter, was inactive on guinea pig ileum[PA0190].

Smooth muscle stimulant activity. Water extract of the seed, at a concentration of 10%, was active on rat jejunum. The effect was abolished by atropine[PA0154].

Toxicity assessment. Ethanol (95%) extract of the dried entire plant, administered intraperitoneally to mice in a mixture containing *Cucumis melo*, *Carum carvi*, *Zea mays*, *Foeniculum vulgare*, *Laurus nobilis*, *Prunus avium*, and *Tribulus terrestris*, produced LD_{50} 7.0 mg/kg[PA0189].

Tumor promotion inhibition. Hexane and methanol extracts of the fruit, in cell culture at a concentration of 50.0 mcg/ml, were equivocal on C3H/10TI/2 cells, and the ethyl acetate extract produced weak activity vs tetradecanoyl phorbol acetate-induced acetate phospholipid synthesis[PA0125].

Uterine relaxation effect. The seed oil, administered intraperitoneally to rats at a dose of 0.1 ml/animal, was active[PA0110].

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21 Ricinus communis

L.

Common Names

Aamudamu chettu	India
Aamudamu	India
Aavanak	India
Agaliva	Guam
Amudamu	India
Andela	Nepal
Ander	Nepal
Angan-tangan	Philippines
Arand	Fiji
Arandi	India
Arundi	Oman
Avend	Nepal
Awriwra	Morocco
Balambaal olyo	Somalia
Balamball	Somalia
Bele ni vavalagi	Somalia
Bherenda	India
Bofareira	USA
Carapate	Guadeloupe
Carrapateira	Brazil
Castor bean plant	Guam
Castor bean	Saudi Arabia
Castor bean	USA
Castor oil bush	West Indies
Castor oil plant	Guyana
Castor oil plant	Nepal
Castor oil plant	USA
Castor	Algeria
Castor	Nepal
Coga macon	East Africa
Dhatura	Nepal
Era	India
Erand	India
Eranda	India
Erande	India
Erandu	India
Erendi	India
Erund	India
Fampinonoana	Madagascar
Harwaa	Tunisia
Higuereta	Cuba
Higuereta	Puerto Rico
Higuerilla blanca	Mexico
Higuerilla	Colombia
Higuerilla	Mexico
Higuerilla	Peru
Higuerillo blanco	Colombia
Higuerillo rojo	Colombia
Higuerillo	Guatemala
Higuero	Nicaragua
Ix K′ O′ Och	Guatemala
Jar	Saudi Arabia
Kastalan qajne	Mexico
Kerwa	Morocco
Kharwa	Egypt
Kharwa	Oman
Kharwaa	Quatar
Kherwa	Jordan
Kherwa	Saudi Arabia
Khiruwi	Sudan
Khirwa	Saudi Arabia
Koli	Hawaii
Krapata	Surinam
Legezabwende	Tanzania
Lepo	Tanzania
Lepo	Tonga

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
By: Ivan A. Ross Humana Press Inc., Totowa, NJ

Lepohina	Tanzania
Lepohina	Tonga
Lepokula	Tanzania
Lepokula	Tonga
Libono	East Africa
Lupono	Tanzania
Mamona	Brazil
Masketi	Haiti
Mbono	East Africa
Mbonu	East Africa
Mupfure	Venda
Mwriki	East Africa
Noronda	India
Ntoo qaib lab	USA-MN
Odagwa	Kenya
Palma christi	Mauritius
Palma christi	USA
Palma christi	West Indies
Palma de Cristo	Brazil
Pomaskwiti	West Indies
Red chicken tree	USA-MN
Red eagle foot	USA-MN
Redh	Fiji
Redhi	Fiji
Rendi	India
Ricin	Tunisia
Ricino	Brazil
Ricino	Colombia
Ricino	Guinea-Bissau
Tel-enderu	India
Tobsha	Saudi Arabia
Tochem-I-bed-anjir	Afghanistan
Toto ni vavalagi	Afghanistan
Ttchakkma	Ethiopia
Txiv taw dlaav laab	USA-MN
Udukaju	Thailand
Unapalan	Nicaragua
Utouto	Nicaragua
Wete pela celik	Argentina

BOTANICAL DESCRIPTION

A perennial of the EUPHORBIACEAE family that grows to 4 m or more in height, with green or maroon stems marked by ring-like scars. The leaves are thick but soft, alternate, peltate, with a palmately lobed blade on a long petiole. Young leaves are purple-bronze and silky. Mature leaves are gray-green or dark purplish-red. The flowers are without petals, males and females on the same dense, terminal bunches. Male flowers have hundreds of stamens, while the female flowers have a superior, 3-lobed ovary. The fruit is a subglobose, brown capsule, somewhat spiny. When immature it is green or red, turning brown when mature and dry. At maturity it splits into 3 sections, each containing a mottled brown seed.

ORIGIN AND DISTRIBUTION

Native to the Old World tropics, most likely Africa. Seeds found in Egyptian tombs are believed to date back 4,000 years. It is now widespread throughout the tropics and warm-temperate regions of the world.

TRADITIONAL MEDICINAL USES

Afghanistan. The seed is eaten a small piece at a time to inhibit pregnancy[RC0286].

Africa. Hot water extract of the dried leaf is taken orally as an emmenagogue[RC0226]. Hot water extract of the leaf is taken orally as a galactagogue and emmenagogue[RC0111].

Algeria. Hot water extract of the dried leaf is taken orally to produce sterility and as an emmenagogue[RC0226]. The seed dipped in the warm blood of a killed rabbit, when eaten by a woman, is thought to prevent conception for 1 year[RC0115]. The seed is taken orally as a contraceptive[RC0114].

Argentina. The powdered seed is applied locally for toothache and acne[RC0173].

Caledonia. The fresh green leaf is applied to the breast as a galactogogue[RC0226].

Cameroon. Hot water extract of the dried leaf is used for filiariasis[RC0191].

Colombia. The seed oil is taken orally at the term of pregnancy to stimulate uterine contractions[RC0107, RC0275].

Cook Islands. The seed oil, mixed with the oil of *Cocos nucifera*, the fruit juice of *Citrus*

aurantium and the crushed leaf of *Cordyline terminalis* is taken orally as a laxative[RC0247].

Cuba. The fresh green leaf is applied over the breast to induce milk production[RC0293].

East Africa. The crushed seed, in water, is taken orally for bleeding after giving birth[RC0151].

Egypt. Hot water extract of the seed is taken orally as a contraceptive[RC0292].

Ethiopia. The dried seed is used to treat skin lesions[RC0166].

Fiji. Infusion of the dried leaf is taken orally as a treatment for retarded growth in children and a strong tea is taken to terminate pregnancy of up to 3 months. The seed oil is used externally as a soothing application for burns and itches, and as a hair restorer[RC0254].

Ghana. Hot water extract of the dried leaf is used externally for guinea worms[RC0191].

Guadeloupe. The seed oil is rubbed on the abdomen and genital area to promote uterine contractions[RC0232].

Guatemala. Hot water extract of the leaf is taken orally for stomach cramps[RC0289].

Guinea-Bissau. Decoction of the leaf is taken orally to accelerate the secretion of milk[RC0105].

Haiti. The fresh leaf is applied externally for rheumatism. The crushed leaf in oil is used for burns, and the boiled leaf is applied externally on sprains and trauma[RC0263]. The seed oil is rubbed on the breast for hypogalactea[RC0226]. The oil is taken orally for nervous shock and rage, externally for pneumonia, bronchitis, rheumatism and cutaneous affections, and together with the crushed leaves on burns[RC0263].

India. For jaundice, the leaves of *Solanum nigrum*, *Ricinus communis*, and *Boerhavia diffusa* are ground together in equal quantities and 10 gm of the paste produced is taken orally, once a day for 7 days[RC0264]. Hot water extract of the leaf is taken orally as an emmenagogue[RC0112]. For malarial fever, castor oil is applied to the leaf that is kept on the patient's head before shivering starts [RC0172]. The dried cotyledon is taken by women to produce permanent sterility. After removing the seed coat, the cotyledons are swallowed on the fifth day of the menstrual cycle. This is continued for about 7 days[RC0279]. The dried leaf, fried in sesame oil is tied around the neck just below the jaw, as a treatment for tonsilitis and throat troubles. For wounds and rheumatism, the leaf with mustard oil is applied as a poultice[RC0170]. For jaundice, the tender leaves, garlic and pepper are macerated in cow's milk and taken orally in the morning for 3 to 5 days[RC0237]. The fresh leaf is warmed and tied locally as a dressing for guinea worm disease. The dressing is changed every night[RC0202]. For sprains, the leaf is smeared with oil, heated, and tied to the affected area[RC0245], and for headache, the warmed leaf is tied on the head[RC0246]. For malaria, the leaf soaked in the seed oil is applied to the head, palms and feet of the patient before shivering starts. Two grams of alum is also administered to the patient orally twice daily[RC0262]. The root, boiled in goat's milk, is applied locally to treat inflammation of lymph glands[RC0158]. Hot water extract of the dried root is taken orally for rheumatism and sciatica[RC0243]. The seed oil is taken orally as an emmenagogue[RC0112] and a strong laxative[RC0237], and is used as an enema for constipation and inflammatory conditions of the bowels. Hot water extract of the seed oil is taken orally for diarrhea and dysentery[RC0243], and as an emmenagogue[RC0269]. The young shoot is taken orally for jaundice[RC0190]. As an abortifacient, a section of the stem is inserted in the vagina[RC0256]. Water extract of the fresh root, together with the roots of *Sterculia urens*, *Ficus benghalensis*, and *Madhuca longifolia* var. latifolia, in equal parts, is taken orally during the first trimester of pregnancy to produce abortion[RC0244].

Italy. The fresh leaf is applied on the breast as a galactagogue and on the affected area to treat tumors[RC0226].

Japan. Water extract of the fresh seed is applied externally to promote hair growth[RC0229].

Kenya. Decoction of the fresh root is taken orally to facilitate expulsion of the placenta or hasten parturition[RC0195].

Liberia. Hot water extract of the root is taken orally as an abortifacient[RC0119].

Madagascar. Hot water extract of the shoot is taken orally as a galactagogue[RC0147].

Mauritius. Hot water extract of the dried leaf is taken orally as an emmenagogue[RC0216].

Mexico. As a febrifuge, the dried leaf is seared on hot coal and placed with raw egg or wild tomato as a compress on the abdomen. The leaf is used as a poultice for swellings and stomachache[RC0234]. Decoction of the fresh green leaf is taken orally to treat infertility in females[RC0248]. The leaf is applied externally for muscular swelling, headache and fever[RC0162]. The young leaf of *Asclepias curassavica* is smeared with the seed oil then eaten for hemorrhoids[RC0234].

Nepal. The seed is taken orally as a purgative[RC0100].

Nigeria. Hot water extract of the fresh root is taken orally as a tonic, sedative, antipyretic and analgesic. Hot water extract of the fresh seed is taken orally as an antipyretic, analgesic, sedative, and tonic[RC0228]. The fermented cotyledons are used as a condiment in soups and sauces[RC0249].

Peru. Hot water extract of the dried seed is taken orally for spleen conditions, blenorrhagia, and as an antiinflammatory and galactagogue[RC0273].

Philippines. The seed is rubbed on the soles of the feet to hasten parturition or expulsion of the placenta[RC0102].

Saudi Arabia. Hot water extract of the dried aerial part is taken orally as an purgative, galactagogue, emmenagogue, anthelmintic, diuretic, bronchodilator, for eye diseases and alopecia[RC0189]. The dried seeds are taken orally as a common medication for good health[RC0301].

Senegal. A decoction of the dried leaf is applied externally for bilharziasis. The seeds are ingested for leprosy[RC0226].

Somalia. A handful of leaves is crushed and mixed with a cup of olive oil. The oily extract is rubbed into the skin of a paralyzed limb twice a day to restore activity. A handful of leaves is crushed and mixed with 1 cup of olive oil. The mixture is applied to the head and 1 drop is placed in each nostril to treat chronic headache. The treatment is continued until the patient is free of pain. For rigid knees, a handful of leaves is crushed and added to a cup of sesame oil. The mixture is filtered and applied to the knees. To treat muscular distortion, the leaves are boiled in water and the decoction applied to distorted muscle. Decoction of the dried root is taken orally to treat intestinal worms. The seed oil is applied to the eye to treat conjunctivitis. For intestinal worms, 50 grams of root is boiled with 2 cups of water until 1 cup remains. One cup is then taken twice daily for 3 days[RC0154].

South Africa. Hot water extract of the leaf is taken orally as an emmenagogue[RC0129]. The powdered, dried root is applied locally as a vaginal antiseptic[RC0226].

South Korea. Hot water extract of the dried seed is taken orally as an emmenagogue, contraceptive, and abortifacient[RC0251]. Hot water extract of the seed is taken orally to induce labor[RC0284].

Sudan. The leaf is applied on the breast to induce milk production[T00368].

Taiwan. Hot water extract of the dried root is taken orally for liver diseases[RC0270].

Tanzania. Hot water extract of the dried root is taken orally to treat diarrhea, stomach ulcers and stomachaches. It is used as an ear drop for earache and the powdered dried root is used as an antiseptic on wounds[RC0164]. Hot water extract of the fresh entire plant is taken orally for venereal diseases, ulcers

and diarrhea, and is used as a fungicide. It is also administered as an ear drop[RC0252]. The dried seed, boiled with the roots of *Psorospermum febrifugum* var. ferrugineum, *Euclea schimperi*, *Albizia atnunesiana*, *Parinari curatellifolia*, *Clerodendrum phlebodes*, *Eteromorpha trifoliata*, *Cassia didymobotrya*, and *Xeromphis* species, is taken orally for epilepsy. For insanity, 1 teaspoon of powdered *Zanha africana* is stirred in 1 quart of water. The foam is removed and the entire amount is taken orally to induce vomiting. If any remains in the stomach it is harmless. The ground bark of *Boscia angustifolia* in water is taken 1 cup daily for 2 days. The entire sequence is repeated then a decoction of *Ricinus communis* and *Boscia angustifolia* is taken, 1 cup in the morning and 1 in the evening for 2 days[RC0253].

Thailand. The entire plant is taken orally as a purgative[RC0260].

Tunisia. Hot water extract of the dried leaf and seed is used externally for rheumatism and inflammation, and orally as a purgative[RC0239].

USA. Fluid extract of the seed is taken orally as a cathartic[RC0127]. Hot water extract of the dried leaf is taken orally as a cathartic[RC0298]. Hot water extract of the entire plant is used by the Laotian Hmong refugees in Minnesota for itching and enlarged liver[RC0276]. The fluid extract is applied to the breast to induce milk production[RC0127].

Venda. The dried fruit, together with *Croton megalobotrys*, is macerated in cold water and the liquid taken orally for roundworms and tapeworms. The powdered fruit is eaten with porridge as a cure for cough, although it causes emesis and diarrhea. The seed oil is rubbed onto incisions made on the body as a tonic[RC0241].

West Africa. Hot water extract of the leaf is taken orally as a galactagogue and emmenagogue[RC0120].

West Indies. The seed oil, mixed with the leaf tea of *Annona muricata*, is taken orally for intestinal worms[RC0209].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Aginine: Sd[RC0132]
Alanine: Pollen[RC0288]
Amyrin, beta: Lf 0.03%[RC0235]
Aspartic acid: Pollen[RC0288]
Astragalin: Lf 18[RC0242]
Avenasterol,5-dehydr: Sd oil[RC0183]
Benzoic acid 2,5-dihydroxy: Lf[RC0161]
Brassicasterol: Pl[RC0296]
Campesterol: Pl[RC0296]
Carotene,beta: Sd[RC0133]
Casbene: Seedling[RC0142]
Catechin,epi (-): Lf[RC0161]
Chlorogenic acid,neo: Lf [RC0161]
Chlorogenic acid: Lf[RC0161]
Chlorophyll A: Lf 0.44%[RC0307]
Chlorophyll B: 0.15%[RC0307]
Corilagin: Lf 0.02%[RC0137]
Coumarin,6,7-dihydroxy-8-methoxy: Fl 0.05%[RC0211]
Coumarin,6,8-dihydroxy-3,4-dimethoxy: Fl 0.035%[RC0211]
Diethylene glycol disulfide: Pl[RC0223]
Ellagic acid: Lf[RC0137]
Enolase: Endosperm[RC0184]
Ethnaolamine, phosphatidyl: Sd[RC0144]
Galactinol: Sd0.19%[RC0168]
Gallic acid: Lf[RC0161,RC0137]
Glutamic acid: Pollen[RC0288]
Glycine: Pollen[RC0288]
Hemagglutinin (Ricinus communis): Sd[RC0176]
Histadine: Pollen[RC0288]
Hyperoside: Lf 0.10%[RC0235], Fl 0.08%[RC0211]
Indole-3-acetic acid: Rt[RC0143]
Kaempferol-3,0-beta-d-rutinoside: Lf 28[RC0242]
Kaempferol-3,0-beta-d-xylopyranoside: Lf 7[RC0242]
Leucine: Pollen[RC0288]
Linoleic acid: Sd oil 2.9-6.5%[RC0221]
Lupan-3-beta-ol-20-one,30-nor: Lf wax[RC0296]
Lupeol: Pl[RC0296]
Methionine: Pollen[RC0288]
Oleic acid: Sd oil 3.1-5.9%[RC0221]
Palmitic acid: Sd oil 0.9-1.5%[RC0221]
Phorbic acid: Lf[RC0302]
Proline: Pollen[RC0288]
Protein: Sd 30.61%[RC0282]
Prunin,2-0-para-coumaroyl: Sd 181.8[RC0139]
Prunin,6-0-para-coumaroyl: Sd 227.2[RC0139]
Quercetin, iso: Lf 310[RC0242]

Quercetin: Lf 0.02%[RC0235]
Quinic acid: Lf[RC0140]
Ricin A: Sd[RC0259]
Ricin A-B-1: Sd[RC0150]
Ricin A-B-2: Sd[RC0150]
Ricin B: Sd[RC0259]
Ricin C: Sd[RC0259]
Ricin D: Sd[RC0178]
Ricin E: Sd[RC0182]
Ricin,alpha: Sd[RC0207]
Ricin,beta: Sd[RC0207]
Ricin,gamma: Sd[RC0207]
Ricin: Lf[RC0226], Sd 0.35mg/seed[RC0240]
Ricine,n-demethyl: Lf 80-160[RC0242]
Ricinine: Sd 0.02%[RC0217], Lf 0.07-0.55%[RC0242], Fl 0.50%[RC0211]
Ricinoleic acid triglycerides: Sd oil 84-91%[RC0221]
Ricinoleic acid: Endosperm[RC0179]
Ricinolein,tri: Sd oil[RC0141]
Ricinus agglutinin RCL-1: Sd[RC0308]
Ricinus agglutinin RCL-II: Sd[RC0308]
Ricinus agglutinin: Sd[RC0259]
Ricinus communis glycoprotein CB-I-A: Sd 0.8%[RC0185]
Ricinus communis hemagglutinin: Sd[RC0281]
Ricinus communis lectin A-2: Sd[RC0210]
Ricinus communis lectin A-I: Sd[RC0210]
Ricinus communis lectin RCA-1: Sd[RC0309]
Ricinus communis lectin, alpha: Sd[RC0177]
Ricinus communis lectin, beta: Sd[RC0177]
Ricinus communis lectin, gamma: Sd[RC0177]
Ricinus communis lectin: Sd[RC0213]
Ricinus communis phytoagglutinin: Sd[RC0126]
Ricinus lectin RCA-120: Sd[RC0310]
Ricinus lectin: Sd[RC0208]
Rutin: Lf 40-7600[RC0242,RC0236], Fl 1200[RC0211]
Serine,phosphatidyl: Sd[RC0144]
Shikimic acid: Lf[RC0140]
Sitosterol,beta: Lf 550[RC0235], Sd oil[RC0183], Pl[RC0296]
Stearicacid: Sd oil 1.4-2.1%[RC0221]
Stigmasterol: Sd[RC0183], Lf 400[RC0235]
Sucrose: Cotyledons[RC0180]
Synthetase,casbene: Sedling[RC0212]
Triricinolein: Endosperm[RC0179]
Tryptophan: Pollen[RC0288]
Tyrosine: Pollen[RC0288]
Valine: Pollen[RC0288]
Vitamin B-1: Fr[RC0287]
Vitamin B-6: Fr[RC0287]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient effect. The seed oil, taken orally by pregnant women at a dose of 60.0 ml, was active[RC0109].

Acid phosphatase inhibition. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 200.0 mg/kg for 7 days, was active vs galactosamine-induced hepatotoxicity[RC0159].

Acid phosphatase stimulation. The seed oil, administered intragastrically to rats at a dose of 2.0 ml/animal, increased the release of intraluminal acid phosphatase in the duodenum and jejunum, but not in the stomach[RC0188,RC0155].

Agglutinin activity. Water extract of the fresh seed, in cell culture at a concentration of 2.0 microliters/ml, was active on the human lymphocytes[RC0304].

Alkaline phosphatase inhibition. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 200.0 mg/kg for 7 days, was active vs galactosamine-induced hepatotoxicity[RC0159].

Allergenic activity. A 21-year old female patient, wearing a necklace with abraded seeds that contacted the skin, went into anaphylactic shock. Skin tests for the seed were positive at 1:10,000,000 dilution[RC0311].

Analgesic activity. Ethanol/water (1:1) extract of the seed, administered intragastrically to mice, was not effective vs hot plate and tail clip method[RC0280]. Water extract of the dried root bark, administered intraperitoneally to rats at a dose of 250.0 mg/kg, was active vs tail-flick response to radiant heat[RC0233].

Antiamoebic activity. Ethanol/water (1:1) extract of the root, in broth culture at a concentration of 125.0 mcg/ml, was active on *Entamoeba histolytica*. Ethanol/water (1:1) extract of the stem, in broth culture at a concentration of 125.0 mcg/ml, was active on *Entamoeba histolytica*[RC0306].

Antibacterial activity. Acetone extract of the dried leaf, on agar plate, was active on *Escherichia coli*, *Salmonella newport*, *Serratia marcescens*, and *Shigella flexneri*, and inactive on *Salmonella* B, *Salmonella typhi*, *Sarcina lutea*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*. The ethanol (95%) extract was active on *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella* B, *Salmonella typhi*, *Serratia marcescens*, *Shigella flexneri*, *Staphylococcus albus*, and *Staphylococcus aureus*, and inactive on *Sarcina lutea*. The water extract was active on *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella newport*, *Salmonella typhi*, *Shigella flexneri*, *Sarcina lutea*, *Staphylococcus albus*, and *Staphylococcus aureus*, and inactive on *Salmonella* B and *Serratia marcescens*. Acetone extract of the dried stem, on agar plate, was active on *Escherichia coli*, *Pseudomonas aeruginosa*, *Shigella flexneri*, and *Staphylococcus aureus*, and inactive on *Salmonella* B, *Salmonella newport*, *Salmonella typhi*, *Sarcina lutea*, *Serratia marcescens*, and *Staphylococcus albus*. The ethanol (95%) extract was active on *Salmonella typhi*, and inactive on *Escherichia coli*, *Pseudomonas aeruginosa*, *Shigella flexneri*, *Staphylococcus aureus*, *Salmonella* B, *Salmonella newport*, *Sarcina lutea*, *Serratia marcescens*, and *Staphylococcus albus*. Water extract was active on *Escherichia coli*, *Sarcina lutea*, *Shigella flexneri*, and *Staphylococcus aureus*, and inactive on *Pseudomonas aeruginosa*, *Salmonella* B, *Salmonella newport*, *Salmonella typhi*, *Serratia marcescens*, and *Staphylococcus albus*[RC0278]. Chloroform extract of dried leaf and stem, on agar plate at a concentration of 4.0 mg/ml, was inactive on *Bacillus subtilis*, *Salmonella typhosa*, and *Shigella dysenteriae*, and produced weak activity on *Salmonella typhosa* and *Escherichia coli*. The ethanol (95%) extract was inactive on *Bacillus subtilis*, *Salmonella typhosa*, *Shigella dysenteriae*, and *Escherichia coli*. The hexane extract was inactive on *Escherichia coli*, and produced weak activity on *Bacillus subtilis* and *Shigella dysenteriae*[RC0230]. Ethanol (95%) extract of the dried leaf (10 ml/g of plant material), on agar plate at a concentration of 5.0 mg/ml, was active on *Bacillus subtilis* and *Staphylococcus aureus*. A concentration of 50.0 mg/ml was inactive on *Escherichia coli* and *Pseudomonas aeruginosa*[RC0268]. Methanol extract of the dried root, on agar plate at a concentration of 10.0 mg/ml, was active on *Staphylococcus aureus*, inactive on *Escherichia coli* and *Neisseria gonorrhea*, and prooduced weak activity on *Shigella boydii*[RC0164]. Seed oil, on agar plate, was inactive on *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhosa*, *Staphylococcus aureus*, and *Vibrio cholera*[RC0283]. Water extract of the fresh entire plant, on agar plate at a concentration of 1.0%, was active on *Neisseria gonorrhea*[RC0252].

Anticholestatic activity. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 25.0 mg/kg for 7 days, was active vs paracetamol-induced hepatotoxicity[RC0159].

Anticonvulsant activity. Ethanol (70%) extract of the fresh root, administered intraperitoneally to mice at variable dosage levels, was active vs metrazole-induced convulsions, and inactive vs strychnine-induced convulsions[RC0228]. Ethanol (70%) extract of the fresh seed, administered intraperitoneally to mice at variable dosages, was active vs metrazole-induced convulsions, and inactive vs strychnine-induced convulsions[RC0228].

Antifilarial activity. Methanol extract of the dried leaf, at a concentration of 0.1%, was active on *Onchocerca volvulvus*[RC0271].

Antifungal activity. Ethanol (95%) extract of the dried leaf (10 ml/g of plant material), on agar plate at a concentration of 50.0 mg/ml, was inactive on *Aspergillus niger*[RC0268]. Seed oil, on agar plate, was inactive on *Trichophyton mentagrophytes*, *Trichophyton rubrum*, and *Aspergillus niger*[RC0283]. The fresh plant juice, on agar plate, was inactive on *Aspergillus niger*[RC0138]. Water extract of the fresh

leaf (1 gm leaf/1 ml water), on agar plate, was active on *Fusarium oxysporum* F. sp. Lentis[RC0163].

Anti-implantation effect. Benzene, ethanol (95%) and petroleum ether extracts of the seed, administered orally to female rats at a dose of 250.0 mg/kg, were not effective[RC0149]. The ethanol (95%)[RC0118] and petroleum ether[RC0145] extracts, at a dose of 500.0 mg/kg, were not effective.

Anti-inflammatory activity. Hot water extract of the root bark, administered orally to rats, was inactive vs formalin-induced pedal edema[RC0116].

Antimycobacterial activity. Fresh plant juice, on agar plate, produced weak activity on *Mycobacterium tuberculosis*[RC0138].

Antioxidant activity. Methanol extract of the seed, at a concentration of 50.0 microliters, produced strong activity[RC0171].

Antischistosomal activity. The seed oil, administered intragastrically to mice at a dose of 0.3 ml/day for 7 days, was active on *Schistosoma mansonii*[RC0192].

Antitumor activity. A suspension of the dried seed oil, administered subcutaneously to mice of both sexes at a dose of 40.0 gm/kg, was inactive on Sarcoma 37[RC0298]. Acetone and water extracts of the dried leaf, administered subcutaneously to mice of both sexes at a dose of 1.0 gm/kg, were inactive on Sarcoma 37[RC0268]. Ethanol/chloroform extract of the dried fruit, administered intraperitoneally to mice at doses of 1.7 and 3.5 mg/kg, were inactive on LEUK-L1210, CA-755 and Sarcoma 180(ASC). A dose of 7.0 mg/kg was inactive on Sarcoma 180(ASC). The seed oil, at a dose of 200.0 mg/kg, was active on Sarcoma-ARS-ascitic, 136% ILS[RC0156].

Antiviral activity. Ethanol (90%) extract of the dried root, in cell culture, was inactive on Sindbis virus and cytomegalovirus[RC0203]. Ethanol/water (1:1) extract of the leaf, in cell culture at a concentration of 50.0 mcg/ml, produced weak activity on vaccinia virus[RC0306]. Ethanol/water (1:1) extract of the seed, in cell culture at a concentration of 0.05 mg/ml, was inactive on vaccinia virus[RC0280].

Antiyeast activity. Ethanol (95%) extract of the dried leaf (10 ml/g of plant material), on agar plate at a concentration of 50.0 mg/ml, was inactive *Candida albicans*[RC0268]. Seed oil, on agar plate, was inactive on *Candida albicans* and *Saccharomyces cerevisiae*[RC0283].

Cytotoxic activity. Ethanol/chloroform (1:1) extract of the dried fruit, in cell culture, was inactive on CA-9KB, ED_{50} > 0.1 mg/ml[RC0290]. Ethanol/water (1:1) extract of the leaf was inactive on CA-9KB, ED_{50} > 20 mcg/ml[RC0306]. Ethanol/water (1:1) extract of the fruit, in cell culture, was active on CA-9KB, ED_{50} < 20.0 mcg/ml[RC0305]. Ethanol/water (1:1) extract of the root, in cell culture, was active on CA-9KB, ED_{50} < 20.0 mcg/ml. Ethanol/water (1:1) extract of the stem, in cell culture, was active on CA-9KB, ED_{50} < 20.0 mcg/ml[RC0306]. The seed oil, in cell culture at concentrations of 0.01% and 1.0%, was inactive on the rat fibroblast[RC0295]. Water extract of the seed, in cell culture, produced strong activity on sarcoma (Yoshida ASC)[RC0121].

Dermatitis producing effect. Two cases of cheilitis due to exposure to seed oil in lipstick were reported[RC0199].

Diuretic activity. Ethanol/water (1:1) extract of the seed, administered intragastrically to rats at a dose of 750.0 mg/kg, was effective[RC0280]. Water extract of the dried aerial part, administered intragastrically to rats at a dose of 5.0 gm/kg, was effective[RC0189].

Embryotoxic effect. Ethanol (95%), water and petroleum ether extracts of the seed, administered orally to rats, were inactive[RC0118, RC0149,RC0145]. Water extract of the dried cotyledon was active on the chicken embryo, results significant at $p < 0.05$ level. The extract of the fermented cotyledons produced weak activity[RC0249].

Estrogenic effect. Ethanol (95%) extract of seed cake, digested with papain to liberate the active principle(s) from the protein complex, was active on the ovariectomized rat[RC0131].

Galactagogue effect. Ethanol (95%) extract of the leaf, taken orally by adults at a dose of 3.75 ml/person, was effective[RC0113].

Glutamate dehydrogenase inhibition. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 200.0 mg/kg for 7 days, was active vs galactosamine-induced hepatotoxicity[RC0159].

Glutamate dehydrogenase stimulation. The dried seed, in the ration of chicks at a concentration of 0.5% of the diet, was active[RC0153, RC0157].

Glutamate oxaloacetate transaminase inhibition. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 200.0 mg/kg for 7 days, was active vs galactosamine-induced hepatotoxicity[RC0159].

Glutamate oxaloacetate transaminase stimulation. The dried seed, in the ration of chicks at a concentration of 0.5% of the diet, was active[RC0153, RC0157].

Glutamate pyruvate transaminase inhibition. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 200.0 mg/kg for 7 days, was active vs galactosamine-induced hepatotoxicity[RC0159]. Ethanol/water (1:1) extract of the dried root, in cell culture at a concentration of 1.0 mg/ml, was active on hepatocytes vs CCl_4-induced hepatotoxicity and PGE-induced pedal edema[RC0270].

Hair stimulant effect. Ethanol (95%) extract of the fresh seed, applied topically on the male mouse at a concentration of 0.4 gm/animal, was inactive[RC0229].

Hematopoietic activity. The dried seed, in the ration of the ewe, produced an elevated leukocyte count, but the RBC count and hemoglobin values remained the same[RC0255].

Hypoglycemic activity. Ethanol/water (1:1) extract of the leaf, administered orally to rats at a dose of 250.0 mg/kg, was effective[RC0306]. Ethanol/water (1:1) extract of the root, administered orally to rats at a dose of 250.0 mg/kg, was active[RC0306]. Ethanol/water (1:1) extract of the stem, administered orally to rats at a dose of 250.0 mg/kg, was effective[RC0306].

Insecticide activity. Acetone extract of the dried seed was inactive on *Culex quinquefasciatus*[RC0136].

Juvenile hormone activity. Ether extract of the fruit, at a concentration of 250.0 mcg/animal, was inactive, and a concentration of 500.0 mcg/ml was active on *Oncopeltus fasciatus*[RC0146].

Larvicidal activity. The essential oil, at a concentration of 25.0 ppm, was active on *Anopheles stephensi* larvae[RC0272].

Laxative effect. Seed oil, in the ration of mice at a concentration of 2.0% of the diet, was inactive vs mecamylamine-induced constipation[RC0135]. A dose of 2.0 ml/animal, administered intragastrically to male rats, produced diarrhea[RC0165].

Lipid synthesis inhibition. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 100.0 mg/kg for 7 days, was active vs galactosamine-induced hepatotoxicity[RC0159].

Lipid synthesis stimulation. The dried seed, in the ration of chicks at a concentration of 0.5% of the diet, was active. Both liver and heart lipid levels were increased[RC0153].

Liver glycogen increase. Ethanol (95%) extract of the dried leaf, administered intragastrically to rats at a dose of 100.0 mg/kg for 7 days, was active vs galactosamine-induced hepatotoxicity[RC0159].

Mitogenic activity. Water extract of the fresh seed, in cell culture at a concentration of 2.0 microliters/ml, was inactive on the human lymphocytes[RC0304].

Molluscicidal activity. The fresh leaf homogenate was inactive on *Lymnaea colum-*

ella and *Lymnaea cubensis*, LD_{100} > 1000 ppm[RC0224]. Water extract of the oven-dried leaf produced weak activity on *Biomphalaria pfeifferi*[RC0265]. Fresh root homogenate was inactive on *Lymnaea columella* and *Lymnaea cubensis*, LD_{100} > 1000 ppm[RC0224]. Homogenate of the fresh fruit was inactive on *Lymnaea columellai* and *Lymnaea cubensis*, LD_{100} > 1000 ppm[RC0224]. Water and ethanol (95%) extracts of the dried seed, at a concentration of 1000 ppm, produced weak activity on *Biomphalaria glabrata* and *Biomphalaria straminea*[RC0294]. Water extract of the oven-dried stem was inactive on *Biomphalaria pfeifferi*[RC0265].

Natriuretic activity. Water extract of the dried aerial part, administered intragastrically to rats at a dose of 5.0 gm/kg, was effective[RC0189].

Nematocidal activity. Decoction of the seed, at a concentration of 10.0 mg/ml, was inactive on *Toxacara canis*[RC0196]. Methanol extract of the dried leaf, on agar plate at a concentration of 7.0 mg/ml, was inactive on *Bursaphelenchus lignicolus*[RC0220]. Water extract of the dried stem, at a concentration of 5.0 mcg/ml, and methanol extract, at a concentration of 1.0 gm/ml, were inactive on *Toxacara canis*[RC0201].

Pheromone (sex attractant and signalling). Ether extract of the inflorescence was equivocal on *Aspiculurus tetraptera, Dacus dorsalis*, male Mediterrean fruit fly and melon fly[RC0148].

Plaque formation inhibition. Methanol and methanol/water (1:1) extracts of the root were active on *Streptococcus mutans*, IC_{50} 230 mcg/ml. The water extract was inactive, IC_{50} > 1000 mcg/ml[RC0258].

Platelet activating factor binding inhibition. Hot water extract of the dried seed, at a concentration of 10.0 mg/ml, produced 36% inhibition on the rabbit platelets[RC0169].

Platelet activating factor stimulation. The seed oil, administered intragastrically to rats at a dose of 2.0 ml/animal, produced more platelet activating factor than controls in the duodenum and jejunum, but not in the stomach[RC0155].

Protease (HIV) inhibition. Water extract of the dried leaf, at a concentration of 200.0 mcg/ml, was inactive[RC0167].

Salidiuretic activity. Water extract of the dried aerial part, administered intragastrically to rats at a dose of 5.0 gm/kg, was effective[RC0189].

Sorbitol dehydrogenase stimulation. The dried seed, in the ration of chicks at a concentration of 0.5% of the diet, was active[RC0153, RC0157].

Spasmolytic activity. Ethanol/water (1:1) extract of the seed was inactive on the rat uterus[RC0280].

Toxic effect. A 52-year old woman, after ingesting 10 to 15 seeds, was presented 4 hours later with severe vomiting and diarrhea, but without abdominal pain or fever. She was hemodynamically stable and liver function was normal. She was treated with gastric lavage and parenteral fluids with good results. One month later she was in a satisfactory condition[RC0197]. An adult who ingested 30 seeds in an attempted suicide was presented with acute abdominal pain, nausea, diarrhea, cramps in the limbs, blurred vision, and circulatory collapse with cyanosis of the extremities. Ricin level was measured in the blood and the half-life was estimated to be 8 days[RC0240]. The dried seed, in the ration of chicks at a concentration of 0.5% of the diet, produced poor growth, dullness, locomotor disturbance, hepatocellular necrosis, lymphocytic infiltration in the portal tracts, and necrosis of cells of the renal convoluted tubules. There was also an increase in serum GOT, SDH, and GDH. Hepatic and cardiac lipid levels were also elevated[RC0157]. Water extract of the leaf, administered intraperitoneally to guinea pigs at a dose of 28.0 gm/kg, caused death within 40–60 minutes of treatment[RC0123]. The entire plant, at a dose of 20.0 gm/kg administered orally, was lethal to 8/12 bovines[RC0174]. The leaf, at a dose of 20.0 gm/kg administered orally, was inactive on the

cow[RC0125]. When the seeds were taken orally by an adult it produced gastroenteritis, fluid and electrolyte depletion, gastrointestinal bleeding, hemolysis and hypoglycemia[RC0200]. The seeds accounted for the death of several thousand ducks in Texas, USA in the fall and winter of 1969–1971. Symptoms were similar to those of botulism. When administered by gastric intubation to ducks, the LD_{50} was 3 to 4 seeds per animal[RC0218].

Toxicity assessment. When the ethanol/water (1:1) extract of the leaf was administered intraperitoneally to mice, the maximum tolerated dose was 100.0 mg/kg. When the ethanol/water (1:1) extract of the root was administered intraperitoneally to mice, the maximum tolerated dose was 1.0 gm/kg[RC0306]. When ethanol/water (1:1) extract of the seed was administered intraperitoneally to mice, LD_{50} > 1.0 gm/kg[RC0280]. When the ethanol/water (1:1) extract of the stem was administered intraperitoneally to mice, the maximum tolerated dose was 500.0 mg/kg[RC0306]. When the seed was administered by gastric intubation, the minimal lethal doses were 14.0 gm/kg for chicken, 5.5 gm/kg for goat, 0.5 gm/kg for goose, 0.1 gm/kg for horse, 2.0 gm/kg for ox, 1.4 gm/kg for pig, 1.0 gm/kg for rabbit, and 1.25 gm/kg for ram[RC0226].

Uterine stimulant effect. Hot water extract of the leaf and stem, at a dose of 33.0 ml/liter, produced weak activity on the rat uterus[RC0110].

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22 Tanacetum parthenium

L.

Common Names

Acetilla	Mexico
Alfinetes de Senhora	Madeira
Altamisa Mexicana	Mexico
Altamisa	Argentina
Artemijio	Brazil
Artemisia	Costa Rica
Artemisia	Madeira
Artmija	Madeira
Boulet	France
Bouton d'argent	France
Camamieri	France
Camomilla	France
Camoumida	France
Camsumilha	France
Canamelha	France
Featherfew	England
Featherfew	USA
Febrifuge plant	USA
Feverfew tansy	Madeira
Feverfew	Canada
Feverfew	Croatia
Feverfew	England
Feverfew	Israel
Feverfew	USA
Hierba Santa Maria	Canary Islands
Luzab	Yemen
Matricaria comun	Argentina
Mutterkraut	Europe
Santa Maria	Argentina
Santa Maria	Mexico
Tanacet	Canada

BOTANICAL DESCRIPTION

A strongly aromatic perennial of the ASTERACEAE family with a taproot or stout caudex. The leaves are finely puberulent beneath, pinnatifid, with rounded, incised, or pinnate segments, evidently petiolate, the blades, up to about 8 cm long and 6 cm wide, are yellowish green. The basal and lower cauline leaves are more or less ovate with 3 to 7 oblong-elliptical to ovate segments, which are subpinnately divided. They are crenate or entire-margined. Heads are numerous in a corymbiform inflorescence, the disk 5–9 mm wide; involucral bracts narrow, the inner with sharply marked hyaline tips; rays 10–20 or more in double forms, 4–8 mm long. The achenes are 1.2 to 1.5 mm and 5 to 8-ribbed.

ORIGIN AND DISTRIBUTION

The plant originated in southeastern Europe, and is now naturalized throughout Europe, in Australia and the Americas.

TRADITIONAL MEDICINAL USES

Argentina. Hot water extract of the dried entire plant is taken orally for stomach

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pains, to regulate the menstrual cycle, as an antitussive and abortive[CP0172].

Brazil. Infusion of the aerial part is taken orally for gastrointestinal problems[CP0132].

Canary Islands. Hot water extract of the dried flower is taken orally as a sedative and carminative. The infusion is taken as a vermifuge[CP0174].

Costa Rica. Hot water extract of the aerial part is taken orally as an emmenagogue[CP0132].

England. Hot water extract of the aerial part is taken orally to expel the afterbirth and to promote menstruation[CP0103]. Hot water extract of the fresh aerial part is taken orally for migraine and as a febrifuge[CP0141]. The leaves are taken orally for migraine, arthritis, and fevers[CP0119,CP0169].

Europe. Hot water extract of the aerial part is taken orally as an emmenagogue[CP0104] and anthelmintic[CP0181]. Hot water extract of the flower is taken orally as an abortifacient and to promote menstruation[CP0139].

France. Infusion of the flowering tops is taken orally as an antispasmodic, carminative, antidiarrheal, aperative, and digestive. The decoction is taken as an emollient[CP0135].

Guatemala. Decoction of the leaf is taken orally for stomach pains[CP0131].

Italy. The dried shoots are used for problems associated with the stomach[CP0180].

Madeira. Infusion of the leaf is taken orally as a diuretic, emmenagogue, and tonic[CP0133].

Mexico. An infusion made from the entire plant is taken orally as a purgative. A decoction of the twigs and leaves is taken orally as a stomachic[CP0128]. Decoction of the fresh branches is taken orally to speed up childbirth, for dysmenorrhea and postpartum recovery, and as an emmenagogue[CP0171]. Hot water extract of the entire plant is taken orally to treat dysmenorrhea, internal parasites and gastrointestinal cramps[CP0134]. Decoction of the fresh flower is taken orally as an emmenagogue and to speed up childbirth [CP0171]. Hot water extract of the dried aerial part is taken orally as an emmenagogue and antispasmodic[CP0164]. The leaf is boiled in large quantities of water and used in a sitz bath to stimulate menstruation[CP0165].

USA. Hot water extract of the dried aerial part is taken orally for flatulence, for colds, as a vermifuge, emmenagogue, carminative and tonic[CP0184]. Hot water extract of the dried leaf is taken orally for arthritis, migraine and asthma[CP0163]. Hot water extract of the flower is taken orally to induce menstrual flow[CP0102]. The flower is taken orally as an abortifacient, emmenagogue, and vermifuge[CP0166].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Alantolactone: Lf[CP0111]
Apigenin-7-glucuronide: Lf[CP0106]
Arbusculin, 1-beta-hydroxy: Pl[CP0162,CP0107]
Artecanin: Aer 0.4[CP0168], Lf[CP0157]
Artemorin: Aer 4.0[CP0168]
Artemorin, epoxy: Lf[CP0136]
Artemorin, epoxy(+): Lf[CP0120]
Artemorin, epoxy(-): Lf[CP0120]
Benzene, butyl: Fl EO[CP0121]
Benzene, para-methyl-iso-propenyl: Fl EO[CP0121]
Benzyl alcohol: Fl EO[CP0121]
Benzyl-2-methyl-butyrate: Fl EO 0.5%[CP0121]
Bicyclogermacrene: Rt 4[CP0168]
Borneol: Fl EO 0.13-1.00%[CP0121,CP0124]
Borneol acetate: Aer 1.2[CP0168], Spadix[CP0115], Fl EO 0.7%[CP0121]
Borneol angelate: Aer 0.8[CP0168]
Cadinene, delta: Spadix[CP0115], EO[CP0124]
Camphene: Spadix 1.96%[CP0115], Fl EO 0.7%[CP0121], Lf EO 3.0%[CP0121]
Camphor: Aer 24[CP0168], Spadix[CP0115], Fl EO 18.9%[CP0121], Lf EO 20.1%[CP0121]
Canin: Aer 0.8[CP0168]
Canin, 10-epi: Aer 4[CP0168]
Car-3-ene: Fl EO[CP0121]
Caryophyllene: Fl EO[CP0121]
Caryophyllene oxide: Fl EO 0.4%[CP0121]
Caryophyllene, beta: Spadix 1.96%[CP0115], EO[CP0124]
Chrysanth-trans-enyl acetate: EO 23.5%[CP0124]
Chrysanthemum parthenium en-yne-bicyclo ether: Rt 3[CP0183]
Chrysanthemum sesquiterpene lactone A: Lf[CP0178]

Chrysanthemum sesquiterpene lactone B: Lf[CP0178]
Chrysanthenol: Aer 2[CP0168]
Chrysanthenol, 4-acetate: Aer 1.2[CP0168]
Chrysanthenol, 4-beta-hydroxy: Aer 3.2[CP0168]
Chrysanthenol, cis, acetate: Aer 1.2[CP0168]
Chrysanthenol, cis, angelate: Aer 1.2[CP0168]
Chrysanthenol, cis, iso-valerate: Aer 0.8[CP0168]
Chrysanthenol, trans, acetate: Spadix 70.0%[CP0115], Fl EO 15.5%, Lf EO 4.7%[CP0121]
Chrysanthenone, 4-beta-acetoxy: Aer 1.2[CP0168]
Chrysoeriol-7-glucuronide: Lf[CP0106]
Costic acid methyl ester: Aer 0.8[CP0168]
Costunolide: Aer 6[CP0168]
Costunolide, 3-beta-hydroxy: Lf[CP0120]
Cumambrin B-3, 4-beta-epoxy-8-deoxy: Fl 485[CP0108]
Cymene, para: Spadix 4.77%[CP0115], Fl EO 0.5%[CP0121], EO 3.1%[CP0124]
Cynaroside: Lf[CP0106]
Dendranthema spirofuran A, cis: Aer 8[CP0168]
Dendranthema spirofuran A, cis-3-alpha-acetate: Aer 4[CP0168]
Dendranthema spirofuran A, cis-3-iso-valerate: Aer 1.2[CP0168]
Dendranthema spirofuran A, trans: Rt 2000, Aer 0.6[CP0168]
Dendranthema spirofuran A, trans 3-alpha acetate: Aer 4[CP0168]
Dendranthema spirofuran A, trans 3-iso-valerate: Aer 0.8[CP0168]
Dioxaspiro-(4,5)-dec-3-ene, 2-(hexa-2,4-diynylidene)-1,6-cis: Aer 1.2, Rt 100[CP0168]
Dioxaspiro-(4,5)-dec-3-ene, 2-(hexa-2,4-diynylidene)-1,6-trans: Aer 0.6[CP0168]
Docos-3-ene: Fl EO 6.0%[CP0121]
Eleutheroside B-1: Lf, twig[CP0153]
Estafiatin, 8-alpha-angeloyl-oxy: Aer 3.2[CP0168]
Estafiatin, 8-alpha-hydroxy: Aer 0.4[CP0168]
Estafiatin, 8-alpha-iso-butyryl-oxy: Aer 2[CP0168]
Eugenol: Spadix 1.09%[CP0115], Fl EO 0.1%[CP0121]
Farnesene, alpha: Fl EO[CP0121]
Farnesene, beta: Aer 12, Rt 40[CP0168]
Farnesene, beta, trans: Spadix[CP0115]
Fraxidin, iso: Rt 121.7[CP0109]
Friedoolean-14-en-3-ol, D: Rt EO 5.3%[CP0121]
Germacrene: Spadix 1.49%[CP0115]
Germacrene A: Pl[CP0112]
Germacrene D: Aer 4.0[CP0168], Lf EO 3.1%[CP0121], EO 4.6%[CP0124]
Hex-cis-3-en-1-ol: Fl EO[CP0121]
Hex-trans-2-en-1-al: Fl EO[CP0121]
Hexan-1-al: Fl EO[CP0121]
Isoamyl iso-valerate: Fl EO 0.2%[CP0121]
Kaempferol, 6-hydroxy-3,7-dimethyl ether: Fl, Lf[CP0106]
Limonene: EO 0.5%[CP0124]
Linalool: Spadix 2.28%[CP0115], EO 1.3%[CP0124]
Linalool acetate: Spadix[CP0115]
Luteolin-7-glucuronide: Lf[CP0106]
Magnolialide: Pl[CP0107,CP0162]
Melatonin: Lf 5.7-3500[CP0114]
Michefuscalide: Lf[CP0145]
Myrcene: Fl EO[CP0121], Spadix[CP0115]
Octanoic acid ethyl ester: Fl EO 0.1%[CP0121]
Parthenolide: Fl EO 28.4%[CP0121], Lf 0.05-1.27%[CP0158,CP0122], Aer 0.040-0.61%[CP0155,CP0154], Fl 0.24%[CP0108], Sd 1.52%[CP0158]
Parthenolide, 1-10-(H)-10,14,14-dehydro-1-beta-hydroxy: Aer 4.4[CP0168]
Parthenolide, 3-beta-hydroxy: Aer 1.2[CP0168]
Pectachol B, 9-epi: Rt 143.4[CP0109]
Penta-2,4-diene, 2-methyl: Fl EO 0.2%[CP0121]
Phellandrene, alpha: Spadix[CP0115], EO 0.6%[CP0124]
Pinene, alpha: Fl EO 0.2%[CP0121], Spadix[CP0115], EO 1.0%[CP0124]
Pinene, beta: Fl EO 0.1%[CP0121], Spadix[CP0115], EO[CP0124]
Pinocarvone: Fl EO 0.2%[CP0121], EO[CP0124]
Quercetagetin-3,3,7-trimethyl ether: Fl, Lf[CP0106]
Quercetagetin-3,7-dimethyl ether: Fl, Lf[CP0106]
Reynosin: Fl 0.148%[CP0108], Pl[CP0168]
Reynosin, 8-beta-hydroxy: Pl[CP0107]
Sabinene: Fl EO 0.1%[CP0121], Spadix[CP0115], EO[CP0124]
Sabinene hydrate: Fl EO[CP0121]
Sabinol: Fl EO 0.13%[CP0121]
Santamarin: Pl[CP0107]
Santamarine: Fl 424.2[CP0108], Pl[CP0162]

Santamarine, epoxy: Fl 30.3[CP0108]
Santin: Pl[CP0101]
Saussurealactine, dehydro: Fl EO 0.6%[CP0121]
Sitosterol, beta: Fl EO, Lf EO 1.6%[CP0121]
Spiroketal enol ether, trans: Fl EO 6.1%, Rt EO 5.1%[CP0121]
Spiroketal enol ether, trans 2-iso-valerate ester: Lf EO 1.3%[CP0121]
Spiroketal enol ether, trans 2-iso-valeryl ester: Fl EO 1.4%[CP0121]
Spiroketol enol ether, cis: Rt EO 57.5%[CP0121]
Stigmasterol: Fl EO[CP0121]
Tanacetin: Aer 1.58%[CP0160]
Tanaparatholide B, seco: Lf[CP0149]
Tanaparthin peroxide: Lf[CP0120]
Tanaparthin-alpha-peroxide: Lf[CP0136], Aer 1.6[CP0168]
Tanaparthin-beta-peroxide: Lf[CP0157], Aer 4[CP0168]
Tanapartholide A, seco: Lf[CP0136], Aer 0.2[CP0168]
Tanapartholide B, seco: Lf[CP0136], Aer 0.8[CP0168]
Tanetin: Fl, Lf[CP0106]
Terpinen-4-ol: Spadix[CP0115], Fl EO 0.1%[CP0121], EO 2.8%[CP0124]
Terpinene, alpha: Spadix[CP0115]
Terpinene, gamma: Fl EO 0.1%[CP0121], Spadix[CP0115], EO 1.0%[CP0124]
Terpineol, alpha: Spadix[CP0115]
Terpinolene: Spadix[CP0115]
Thujene, alpha: Fl EO 0.2%[CP0121], EO 0.6%[CP0124]
Verlototin, anhydro 3-beta-hydroxy: Aer 1.2[CP0168]
Verlotorin, anhydro 4-alpha-5-beta epoxide: Aer 1.2[CP0168]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Allergenic activity. Sesquiterpene lactone fraction of the dried aerial part tested positive on 4.5% of the 30 patients tested[CP0126].

Analgesic activity. The dried leaf, when taken orally by patients with migraine for 2 months, reduced the number and severity of attacks and the degree of vomiting[CP0146]. The freeze-dried leaf was taken orally by seventeen migraine patients in a double-blind study with either the plant material or placebo. The patients treated with the plant material had a lower incidence and severity of headaches[CP0170].

Antibacterial activity. Acetone extract of the dried leaf, at a concentration of 50.0 mg/disc on agar plate, was active on *Streptococcus pyogenes* and produced MIC 1.0 mg/disc for *Streptococcus pneumoniae*[CP0129]. The ethanol (95%) extract, at a concentration of 50.0 mg/disc, was active on *Streptococcus pneumoniae* and *Streptococcus pyogenes*[CP0123]. The extract was equivocal on *Escherichia coli*, *Salmonella typhimurium*, and *Shigella flexneri*. The hexane extract, at a concentration of 50.0 mg/disc, was active on *Streptococcus pyogenes*, and had weak activity on *Streptococcus pneumoniae*[CP0129]. Essential oil of the unripe spadix, on agar plate, was inactive on *Enterococcus* species, *Proteus rettgeri*, *Pseudomonas aeruginosa*, *Sarcina flava*, and *Staphylococcus aureus*, and active on *Escherichia coli*, MIC 0.39%; *Bacillus subtilis*, MIC 0.59%; *Klebsiella oxytoca*, MIC 0.78%; *Salmonella* species, MIC 0.78%; *Serratia marinorubra*, MIC 0.78%; *Shigella sonnei*, MIC 0.78%; *Bacillus cereus*, MIC 3.12% and *Citrobacter freundii*, MIC 3.12%[CP0115]. Ethanol (40%) extract of the dried leaf, on agar plate, was inactive on *Escherichia coli*, *Klebsiella oxytoca*, *Proteus mirabilis*, *Proteus morganii*, *Proteus rettgeri*, *Salmonella* species, *Serratia* species, *Shigella sonnei*, *Bacillus pumilus*, *Enterobacter* species, and *Bacillus subtilis*, and produced weak activity on *Sarcina flava*, *Staphylococcus aureus*, and *Staphylococcus hemolyticus*, MIC 12.5%, 25.0% and 25.0%, respectively. The ethanol (90%) extract was inactive on *Enterobacter* species, *Klebsiella oxytoca*, *Salmonella* species, *Shigella sonnei*, *Bacillus pumilus*, and *Bacillus subtilis*, and produced weak activity on *Escherichia coli*, *Sarcina flava*, *Staphylococcus aureus*, *Serratia* species, *Staphylococcus hemolyticus*, *Proteus mirabilis*, *Proteus morganii*, and *Proteus rettgeri* [CP0137]. Ethanol (95%) and water extracts of the

entire plant, on agar plate, were active on *Escherichia coli* and *Staphylococcus aureus*[CP0105]. Ethanol/water (1:1) extract of the dried flower, leaf and stem, on agar plate at a concentration of 5.0 mg/ml, was active on *Sarcina lutea* and *Staphylococcus aureus*, and inactive on *Escherichia coli*[CP0179]. Ethanol (50%) extract of the dried flowers, on agar plate at a concentration of 50.0 microliters/disc, was active on *Salmonella enteritidis*, and inactive on *Escherichia coli*, *Salmonella typhosa*, *Shigella typhosa*, *S. dysenteriae*, and *S. flexneri*[CP0130]. Water extract of the dried leaf and stem, at a concentration of 20.0 mg/ml on agar plate, was active on *Escherichia coli*, *Salmonella typhosa*, and *Shigella boydii*[CP0127]. Ethanol (95%) extract of the dried seed, at variable concentrations on agar plate, was equivocal on *Bacillus globifer* and *Escherichia coli*. The extract was inactive on *Aerobacter aerogenes*, *Escherichia coli* (streptomycin resistant), *Pseudomonas aeruginosa*, *Serratia marcescens*, and *Staphylococcus aureus*; it had strong activity on *Bacillus globifer* (tetracycline resistant), and it produced weak activity on *Bacillus globifer* (erythromycin resistant), *Bacillus mycoides*, *Bacillus subtilis*, *Proteus morganii* and *Proteus vulgaris*[CP0167].

Antifungal activity. Essential oil of the unripe spadix, on agar plate, was active on *Trichophyton mentagrophytes*, MIC 1.56%; *Microsporum gypseum*, MIC 3.125%; equivocal on *Epidermophyton floccosum*, MIC 25.0%; *Aspergillus niger*, MIC 50.0%; and produced weak activity on *Aspergillus flavus*, MIC 6.3% and *Aspergillus ochraceus*, MIC 6.4%[CP0115]. Ethanol (40% and 90%) extract of the dried leaf, on agar plate, produced weak activity on *Trichophyton mentagrophytes*, MIC 4.0%[CP0137]. Ethanol (95%) extract of the dried seed, at variable concentrations on agar plate, was inactive on *Fusarium solani*, *Fusarium culmoun*, *Penicillium notatum*, and *Scopulariopsis* species[CP0167]. The leaf, on agar plate at a concentration of 100.0 mcg/ml, was active on *Colletotrichum acutatum*. Zero to 4% of conidia germinated compared to 79–90% of control after 20 hours of incubation[CP0161].

Anti-inflammatory activity. The dried leaf, taken orally by adults at a dose of 70.0 mg/day for 6 weeks, was inactive in a double-blind study vs rheumatoid arthritis[CP0148].

Antimigraine effect. Ethanol (95%) extract of the fresh leaf, taken orally by 50 adults who have never taken this plant material before at a dose of 0.5 mg/day, was inactive. The efficacy of the leaf, in capsules, on migraine prophylaxis was studied in a randomized double-blind, placebo-controlled crossover study. At the end of the 9-month study, the 44 patients who completed the study suffered the same number of migraine attacks. A prophylactic effect could not be demonstrated for the feverfew preparation. However, the patients used fewer symptomatic drugs during the period they used the extract[CP0138]. The oven-dried leaves were taken orally by 57 adults of both sexes, at a dose of 100.0 mg/day for 4 months, in a double-blind, placebo-controlled cross-over study. Both groups were treated with the plant product in the preliminary phase of the study, which lasted 2 months. In the second and third phases, a double-blind, placebo-controlled cross-over study was conducted. The results obtained indicated that the plant product caused a significant reduction in pain intensity compared with the placebo treatment. There was also a profound reduction concerning the severity of the typical symptoms that are usually linked to migraine attacks, such as vomiting, nausea, and sensitivity to noise and light. When the treated group was transferred to the placebo treatment, there was an augmentation of the pain intensity as well as an increase in the severity of the associated symptoms. In contrast, changing the placebo group to treatment with the plant product resulted in a reduction in the pain intensity, as well as in the severity of the associated symptoms[CP0113].

Antimycobacterial activity. Ethanol (95%) extract of the dried seed, at variable concentrations on agar plate, was inactive on *Mycobacterium phlei* and *Mycobacterium smegmatis*[CP0167]. Ethanol (95%) extract of the entire plant, on agar plate, was inactive on *Mycobacterium tuberculosis*. The water extract produced a weak activity that was lost in the presence of whole blood[CP0105].

Antisecretory effect. Chromatographic fraction of the dried leaf, at a concentration of 2.0 mg/ml in cell culture, was active on platelets[CP0140].

Antitumor activity. Ethanol (50%) extract of the leaf and stem, administered intraperitoneally to mice, was active on LEUK-P388[CP0100].

Antiyeast activity. Essential oil of the unripe spadix, on agar plate, was active on *Candida tropicalis*, MIC 1.6%; *Candida pseudotropicalis*, *Cryptococcus neoformans*, *Candida species*, and *Hansenula anomala*, MIC 3.12%[CP0115]. Ethanol (40% and 90%) extract of the dried leaf was inactive on *Candida parapsilosis*, and produced weak activity on *Candida albicans*. The 90% extract produced weak activity on *Candida pulcherima* and *Candida tropicalis*[CP0137]. Ethanol (60%) extract of the dried flower, on agar plate, was inactive on *Candida albicans*[CP0159]. Ethanol (95%) extract of the dried seed, at variable concentrations on agar plate, was inactive on *Kloeckera brevis* and *Saccharomyces cerevisiae*[CP0167].

Cell aggregation inhibition. Chloroform extract of the dried leaf was active on leukocytes vs polymorphonuclear leukocyte aggregation induced by ionophore[CP0144].

Chromosomal aberration induction. The leaf, taken orally for 11 months by 30 patients with migraine headache, was inactive on the lymphocytes[CP0176]. The dried leaf, taken by adults at a dose of 73.0 mg/person for 11 months or longer, was inactive[CP0156].

Cyclo-oxygenase inhibition. Water extract of the dried leaf, at a concentration of 1:20, was active on platelets[CP0142]. Water extract of the fresh aerial part, at a concentration of 50.0 mcg/ml, was inactive on platelets[CP0141].

Cytotoxic activity. Ethanol (50%) extract of the leaf and stem, in cell culture, was active on CA-9KB, ED_{50} <20.0 mcg/ml[CP0100].

Degranulation inhibition. Chloroform/methanol (1:3) extract of the dried leaf was active on the human polymorphonuclear leukocytes vs sodium arachidonate-, formyl-methionyl-leucyl-phenylalanine-, and calcium ionophore-induced degranulation[CP0169].

Histamine release inhibition. Chloroform extract of the dried leaf, at a concentration of 1:320, was active on rat peritoneal cells vs stimulation with anti-IgE or ionophore A-23187[CP0175].

Insecticide activity. Acetone extract of the dried flower, at a concentration of 5.0% sprayed on *Macrosiphoniella sanborni*, produced weak activity[CP0182]. Acetone extract of the dried leaf and stem, at a concentration of 5.0%, produced weak activity when sprayed onto *Macrosiphoniella sanborni*[CP0182].

Leukotriene B-4 production inhibition. Chloroform extract of the leaf, at a concentration of 100.0 mcg/ml, was active on rat leukocytes stimulated by calcium ionophore A23187[CP0119]. Chloroform extract of the fresh leaf, at a dose of 50.0 mcg/ml, was active on human and rat leukocytes stimulated by n-formyl-methionyl-leucyl-phenylalanine or calcium ionophore A23187. The water extract, at a concentration of 500.0 mcg/ml, was inactive on rat leukocytes stimulated by calcium ionophore A23187[CP0119].

Lipoxygenase inhibition. Water extract of the dried entire plant (20 mg of plant material per ml), at a dose of 50.0 mcg/ml, was active on the rat leukocytes[CP0173].

Mutagenic activity. The dried leaf, taken orally by adults at a dose of 73.0 mg/person for eleven months or longer, was inactive. The urine of the patients was assayed using the Ames test[CP0156].

Oxidative burst inhibition. Acetone and saline extracts of the dried leaf, at a con-

centration of 1:108, were active, and the chloroform extract produced weak activity on the human polymorphonuclear leukocytes vs phorbol 12-myristate-13-acetate-induced oxidative burst[CP0110].

Phagocytosis inhibition. Chloroform extract of the dried leaf, at a concentration of 100.0 microliters/ml, was active vs zymosan-induced chemiluminescence in whole blood. A concentration of 200.0 microliters/ml was active on leukocytes vs ingestion of liposomes and of zymosan particles[CP0144].

Phospholipase A-2 inhibition. Ethanol (95%) and water extract of the dried leaf was active[CP0143]. Water extract of the dried leaf was active[CP0142].

Platelet adhesion inhibition. Chloroform extract of the dried leaf, at variable concentrations, was active vs platelet-collagen interaction[CP0147]. A concentration of 10.0 mg/ml was active vs arachidonic acid-induced aggregation; a concentration of 12.5 mg/ml was active vs adrenaline-induced aggregation and a concentration of 25.0 mg/ml was active vs PMA-induced aggregation [CP0151]. The water extract was active. The activity was caused by the blocking of sulfhydryl groups[CP0177].

Platelet aggregation inhibition. Chloroform extract of the dried leaf, in cell culture, was active vs arachidonic acid-, collagen-, and epinephrine-induced aggregation[CP0150]. Water extract of the dried leaf, at a concentration of 1:20, was active vs ADP-, collagen- and thrombin-induced aggregation[CP0142].

Polymorphonuclear leukocyte activation. Acetone extract of the freeze-dried leaf was active vs phorbol myristate acetate-induced chemiluminescence[CP0116].

Potassium channel-blocking activity. Chloroform extract of the fresh leaf, at a concentration of 100.0 mcg/ml, was active on rabbit arterial muscle. Voltage-dependent potassium current was inhibited, but calcium-dependent channels were unaffected. The extract also inhibited the voltage-dependent potassium current in rat anococcygeus muscle, IC_{50} 56.0 mcg/ml[CP0125].

Prostaglandin inhibition. Water extract of the dried entire plant (20 mg of plant material per ml), at a dose of 50.0 mcg/ml, was active on rat leukocytes[CP0173]. Water extract of the fresh aerial part, at a concentration of 50.0 mcg/ml, was active[CP0141].

Prostaglandin synthetase inhibition. Chromatographic fraction of the fresh leaf was active, IC_{50} 200.0 mcg/ml[CP0145].

Protein synthesis stimulation. Chloroform extract of the dried leaf, in cell culture, was active on plates when adrenaline or arachidonic acid were added[CP0150].

Serotonin secretion inhibition. Ethanol (95%) extract of the fresh leaf was active on bull platelets, IC_{50} 2.937 mg/ml[CP0117]. Acetone extract of the dried leaf, at a concentration of 48.0 mg/ml, was active on platelets[CP0122]. Chloroform extract, in cell culture, was active vs arachidonic acid-, collagen-, and adrenaline-induced serotonin release [CP0150]. Chloroform/methanol (1:3) extract of the dried leaf was active on platelets vs calcium ionophore-, ADP-, epinephrine-, arachidonic acid-, collagen-, and U46619-induced aggregation[CP0169].

Sister chromatid exchange stimulation. The dried leaf, taken orally by adults at a dose of 73.0 mg/person for 11 months and longer, was inactive on lymphocytes[CP0156]. The leaf, taken orally for 11 months by 30 patients with migraine headache, was inactive on lymphocytes[CP0176].

Spasmogenic activity. Chloroform extract of the dried leaf, at a concentration of 250.0 mcg/ml, was active on rabbit aorta. Ketanserin (SHT-2 antagonist) had no effect on the activity[CP0120].

Spasmolytic activity. Chloroform extract of the dried leaf, at a concentration of 250.0 mcg/ml, was inactive on rabbit aorta vs epinephrine-, and 5-HT-induced contractions[CP0120]. The dried leaf, at a concentra-

tion of 200.0 mcg/ml, was inactive vs serotonin-, phenylephrine-, thromboxane-, angiotensin-, and mimetic U46619-induced contractions[CP0152]. Chloroform extract of the fresh leaf, at a concentration of 200.0 mcg/ml, was active on rabbit aorta vs serotonin-, thromboxane mimetic U46619-, angiotensin- and phenylephrine-induced contractions[CP0118,CP0152]. Chloroform extract of the fresh leaf, at a concentration of 100.0 mcg/ml, was active on rabbit aorta vs 5-HT-, angiotensin II-, epinephrine- and carbachol-induced contractions[CP0120].

Thromboxane B-2 synthesis inhibition. Chloroform extract of the fresh leaf was active on the human and rat leukocytes stimulated by n-formyl-methionyl-leucyl-phenylalanine and calcium ionophore A-23187[CP0119]. Chloroform/methanol (1:3) extract of the dried leaf was active on platelets vs epinephrine-induced aggregation, and inactive vs epinephrine-induced arrhythmia and ADP- and thrombin-induced aggregation[CP0169]. Water extract of the dried entire plant (20 mg of plant material per ml), at a dose of 50.0 mcg/ml, was active on the rat leukocytes[CP0173].

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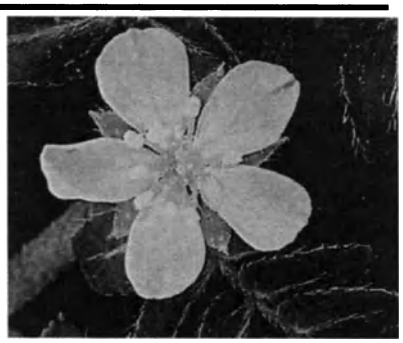

Common Names

Abrojo	Peru
Akanti	India
Bakhra	India
Bastitaj	India
Betagokhru	India
Bhakra	India
Bhakra	Pakistan
Bullhead	Kuwait
Burra gookeron	Kuwait
Calthrop	India
Caltrap	India
Caltrop	Australia
Caltrop	Kuwait
Chinnipalleru	India
Chirupalleru	India
Chota gokharu	India
Cow's hoof	India
Croix de Malte	India
Demirdiken	Turkey
Deshi gokhru	India
Devil's thorn	India
Ekanty	India
Gai ma duong	China
Gatha	Qatar
Gokhatri	India
Gokhru	India
Gokhrudesi	India
Gokhuru	Pakistan
Gokshura	India
Ikshugandha	India
Jili	Taiwan
Jilisi	China
Kandalai	Pakistan
Kanti	India
Khokkrasan	Thailand
Kokulla	India
Krunda	India
Lahhango-khru	India
Lotak	India
Meethagokhru	India
Mithgokhru	India
Nahhanagokhru	India
Nerenchi	Sri Lanka
Nerinjeekai	India
Nerunji	India
Pakhra	Pakistan
Palleru	India
Pallerukayalu	India
Pedda palgeru	India
Puncture vine	USA
Rasha	India
Sanna neggilu	India
Sarala	India
Sharatte	India
Shitsurishi	China
Small caltrop	Kuwait
Tat le	China
Tsi li	China
Zama	India

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BOTANICAL DESCRIPTION

An annual, prostrate or semierect, diffusely branched herb of the ZYGOPHYLLACEAE family. It grows up to 90 cm in length. The root is slender, cylindrical, somewhat fibrous, 10–15 cm long, light brown and faintly aromatic. The leaves are paripinnate. Leaflets, 5–8 pairs, are subequal, oblong to linear-oblong. Flowers are leaf-opposed, solitary, and pale-yellow. The fruit is globose, consisting of 5–12 woody cocci, each with 2 pairs of hard, sharp, and divaricate spines, 1 pair longer than the other. The seeds are several in each coccus with transverse partitions between them.

ORIGIN AND DISTRIBUTION

A native of Europe, it grows on dry or sandy soil along roads and highways. It is now found in the tropics and warm-temperate regions of the world.

TRADITIONAL MEDICINAL USES

Bulgaria. The dried aerial part is taken orally to increase spermatogenesis and libido[TT0179].

China. Hot water extract of the aerial part is taken orally, in doses of 7 to 10 gm, as a tonic in spermatorrhea[TT0121]. Hot water extract of the dried seed is taken orally for liver diseases[TT0192]. The defatted fruit is taken orally for eye troubles, edema, abdominal distention, and leucorrhea[TT0112]. Water extract of the dried fruit is used externally to treat hyperpigmentation of the skin, such as melasma and ephekides, in order to enhance the beauty of the skin[TT0169]. The fruit is taken orally by pregnant women as an abortive[TT0106]. The powdered, dried plant is mixed with butter and honey and licked to promote longevity[TT0200].

Europe. Hot water extract of the leaf is taken orally as a galactagogue, diuretic and antidiarrheal[TT0210].

India. Decoction of the entire plant is taken orally to treat leucorrhea[TT0135], and the hot water extract is taken orally as an aphrodisiac[TT0208]. Hot water extract of the dried plant is taken orally for renal or urinary calculi[TT0198]. Hot water extract of the root is taken orally as an emmenagogue[TT0104]. The fresh seed is taken orally with honey as a tonic, to improve vitality and luster of the skin, to prevent wrinkles and to treat jaundice[TT0181]. The powdered, dried fruit and twigs are taken orally as a narcotic. When taken in excess it will cause delirium[TT0205]. The fresh fruit juice is taken orally for urinary complaints[TT0152]. The powdered, dried root is taken orally, 3 times daily, for gonorrhea[TT0137]. Water extract of the fruit is taken orally as a tonic, diuretic, and aphrodisiac[TT0105]. The infusion is taken orally as a uterine tonic[TT0138], and the fruit is taken orally for impotence in Ayurvedic medicine[TT0174]. Infusion of the fruit is taken orally for urinary calculus and as a diuretic[TT0127]. Infusion of the dried fruit is taken orally as a treatment for urolithiasis[TT0126] and gonorrhea, as a cooling tonic, as a diuretic for gout[TT0177], and for urinary and kidney diseases[TT0189]. For acute debility after childbirth, a 1:2 mixture of *Tribulus terrestris* fruit and *Curculigo orchiodes* root is given with the juice of *Echinops echinatus* root[TT0152].

Kuwait. Hot water extract of the root is taken orally as an aphrodisiac[TT0139].

Nepal. Hot water extract of the fruit is taken orally as an aphrodisiac and for impotence, and as a tonic and diuretic[TT0100].

Pakistan. The fruit is taken orally to treat impotence and as an aphrodisiac[TT0101].

Peru. Hot water extract of the dried aerial part is taken orally as a diuretic and anti-inflammatory[TT0202].

South Korea. Hot water extract of the dried fruit is taken orally as an abortifacient[TT0190]. Hot water extract of the seed is taken orally for liver diseases[TT0166].

Tanzania. The leaf is used as a vegetable in the normal diet[TT0134].

Thailand. Hot water extract of the dried root is taken orally as a diuretic[TT0211].

Turkey. Decoction of the seed is taken orally to pass kidney stones[TT0136].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Aspartic acid: Fr[TT0164]
Astragalin: Fr, Lf[TT0222], Aer[TT0220]
Bioscin prosapogenin A sulfate: Aer[TT0108]
Calcium: Fr 0.144%[TT0120]
Campesterol: Fl[TT0141], Rt[TT0213]
Chlorogenin: Aer 0.17%[TT0218]
Daucosterol: Aer[TT0162]
Dioscin prosapogenin A: Aer[TT0108]
Dioscin, proto: Aer[TT0108]
Dioscin: Aer 55[TT0162]
Diosgenin: Rt 0.13%[TT0124], Pl 0.15-0.98%[TT0212,TT0183], Aer 0.35-0.80%[TT0218,TT0161], St 0.78%[TT0124]
Fatty acids: Sd[TT0145]
Furost-20(22)en-12-one-3-beta-26-diol, 5-alpha 26-O-beta-d-glucopyranosyl-3-O-[[beta-d-xylopyranosyl(1,3)]-beta-d-galactopyransoyl(1,2)]-beta-d-glucopyranosyl (1,4)-beta-d-glucopyranosyl: Aer 10[TT0111]
Furostan-12-one-3-beta-22,26-triol, 5-alpha 26-O-beta-d-glucopyranosyl-3-O-[[beta-d-xylopyranosyl(1,3)]-beta-d-galactopoyranosyl(1,20]-beta-d-glucopyranosyl(1,4)-beta-d-glucopyranosyl: Aer 8[TT0111]
Gigenin, neo: Pl[TT0113]
Gitogenin, neo: Fl[TT0141]
Gitogenin: Pl[TT0221], Aer 0.111%[TT0218]
Gitonin, F: Fr[TT0110]
Gitonin: Fr[TT0110]
Glutamic acid: Fr[TT0164]
Gracillin, proto: Aer[TT0108]
Gracillin: Aer[TT0108]
Harmaline: Pl[TT0130]
Harmalol: Pl[TT0130]
Harman, nor: Pl[TT0125]
Harman: Pl[TT0130]
Harmine, tetrahydro: Pl[TT0144]
Harmine: Pl[TT0130]
Harmol: Pl[TT0219]
Hecogenin, neo, 3-O-beta-d-glucopyranoside: Aer 50[TT0162]
Hecogenin: Pl[TT0173]
Hecogenin-3-O-beta-d-glucopyranosyl(1,4)-beta-d-galactopyranoside: Aer 20[TT0111]
Indan-1-one, hydro, 7-methyl: Pl[TT0109]
Kaempferol: Aer[TT0216]
Kaempferol-3-gentiobioside: Lf[TT0163]
Kaempferol-3-gentiobioside-7-glucoside: Lf[TT0163]
Kaempferol-3-O-beta-d-rutinoside: Lf[TT0163]
Kaempferol-3-para-coumaroyl-glucoside: Lf[TT0163]
Kaempferol-3-rutinoside: Fr, Lf[TT0222]
Kikubasaponin: Pl[TT0180,TT0115]
Lanatigonin II, degluco: Fr[TT0110]
Linoleic acid: Pl[TT0105]
Nitrate: Fr[TT0105]
Oleic acid: Pl[TT0203,TT0105]
Palmitic acid: Sd[TT0105]
Potassium: Fr 0.42%[TT0120]
Protein: Fr 10.85%[TT0164]
Quercetin, iso: Lf[TT0163]
Quercetin: Fr, St[TT0131], Fl[TT0141]
Quercetin-3-gentibioside: Lf[TT0163]
Quercetin-3-gentiobioside: Lf[TT0143]
Quercetin-3-gentiobioside-7-glucoside: Lf[TT0163]
Quercetin-3-gentiobioside-7-glucoside: Lf[TT0143]
Quercetin-3-gentiotrioside: Lf[TT0163]
Quercetin-3-rhamnogentiobioside: Lf[TT0163]
Rhamnetin, iso, 3,7-di-O-beta-glucoside: Lf[TT0163]
Rhamnetin, iso, 3-gentiobioside: Lf[TT0163]
Rhamnetin, iso, 3-gentiobioside-7-glucoside: Lf[TT0163]
Rhamnetin, iso, 3-O-beta-d-glucoside: Lf[TT0163]
Rhamnetin, iso, 3-O-beta-d-rutinoside: Lf[TT0163]
Rhamnetin, iso, 3-para-coumaroyl-glucoside: Lf[TT0163]
Ruscogenin: Pl[TT0113]
Ruscogenin-1-O-alpha-L-rhamnopyranosyl (1,2)-beta-d-6-O-acetyl-glucopyranosyde: Pl[TT0113]
Rutin: Lf 0.58%, Fr 0.51%[TT0178]
Rutin: Lf[TT0143]
Sitosterol, beta: Pl[TT0186]
Sodium: Fr 0.64%[TT0120]
Spirosta-3,5-diene, 25 (D): Pl[TT0221]
Spirosta-3,5-diene: Fl[TT0160]
Stearic acid: Sd[TT0105]
Stigmasterol: Pl[TT0186]
Terrestriamide: Pl[TT0109]
Terrestroside F: Pl[TT0173]
Terrestrosin A: Fr[TT0110]
Terrestrosin B: Fr[TT0110]

Terrestrosin C: Fr[TT0110]
Terrestrosin D: Fr[TT0110]
Terrestrosin E: Fr[TT0110]
Terrestrosin F: Fr 0.1458%[TT0112]
Terrestrosin G: Fr 0.325%[TT0112]
Terrestrosin H: Fr 0.342%[TT0112]
Terrestrosin I: Fr 0.167%[TT0112]
Terrestrosin J: Fr 0.042[TT0112]
Terrestrosin K: Fr 0.079[TT0112]
Tigogenin: Pl[TT0113]
Tigogenin-3-O-[beta-d-xylopyranosyl(1,2)-(beta-d-xylopyranosyl(1,3))]-beta-d-glucopyranosyl(1,4)-(alpha-L-rhamnopyranosyl(1,2)-beta-d-galactopyranoside: Fr[TT0110]
Tigonenin, neo: Pl[TT0113]
Tigonin, deglacto: Fr[TT0110]
Tribuloside: Fr, Lf[TT0222]
Tribulosin: Aer 90[TT0162]
Tribulus polysaccharide H: Lf, St[TT0107]
Tribusponin: Lf[TT0140]
Trillarin: Aer[TT0108]
Trillin: Pl[TT0185]

PHARMACOLOGICAL ACTIVITIES AND CLINICAL TRIALS

Abortifacient effect. The dried plant, administered intragastrically to pregnant ewes at a dose of 400.0 gm/animal, was inactive[TT0207].

Analgesic activity. Chloroform extract of the dried entire plant, administered intraperitoneally to mice at a dose of 500.0 mg/kg, was active vs tail clip method[TT0146]. Hot water extract of the dried aerial part, administered intraperitoneally to mice of both sexes at a dose of 150.0 mg/kg, was active vs hot plate method[TT0201]. The dried fruit, administered by gastric intubation to mice at a dose of 0.5 gm/kg in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active vs acetic acid-induced writhing[TT0154].

Androgenic activity. The plant, in a preparation containing *Lactuca scariola*, *Hygrophila spinosa*, *Parmelia parlata*, *Macuna pruriens*, *Argyreia speciosa*, and *Leptadenia reticulata*, administered orally to castrated mice pretreated with testosterone subcutaneously at a dose of 7.70 mg/animal for 4 days, was active. A dose of 22.0 mg/animal increased the maltase activity of the dorsoventral prostate and the fructose content of the seminal vesicle[TT0209].

Anthelmintic activity. The alkaloid fraction and ethanol (95%) extract of the dried entire plant, administered orally to chickens, were active on *Ascaridia galli*[TT0167].

Antiallergenic activity. Decoction of the plant, at a concentration of 250.0 mcg/ml in a preparation containing *Ledebouriella seseloides*, *Potentilla chinensis*, *Clematis armandii*, *Rehmannia glutinosa*, *Paeonia albiflora*, *Lophaterum gracile*, *Dictamnus dasycarpus*, *Glycyrrhiza glabra*, and *Schizonepeta tenuifolia*, in cell culture, was active on monocytes vs interleukin 4-induced CD23 expression as a model of atopy[TT0129]. The dried fruit, administered by gastric intubation to mice at a dose of 0.5 gm/kg in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active vs picryl chloride-induced contact dermatitis[TT0154].

Antianaphylactic activity. Water extract of the dried fruit, at a concentration of 1.0 mcg/ml, was inactive on the rat LEUK-RBL 2H3 vs biotinyl IgE-avidin complex-induced degranulation of beta-hexosaminidase[TT0133].

Antiascariasis activity. Ethanol extract (95%) of the seed produced paralysis in 18 hours and no deaths[TT0114].

Antibacterial activity. Chloroform extract of the dried entire plant, on agar plate, was active on *Staphylococcus aureus*, MIC >83.2 gm/liter. The methanol extract, at a concentration of 1.0 gm/liter, was inactive on *Klebsiella pneumoniae* and *Staphylococcus aureus*[TT0151]. Chloroform extract of the dried leaf and stem, at a concentration of 4.0 mg/ml on agar plate, was inactive on *Escherichia coli*, *Salmonella typhosa*, and *Shigella dysenteriae*, and produced weak activity on *Bacillus subtilis*[TT0176]. Ethanol (95%) extract

of the dried aerial part, on agar plate at a concentration of 100.0 mg of plant material/disc, and the water extract at a concentration of 20.0 mg/disc, were inactive on *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhosa*, and *Shigella dysenteriae*. The water extract was active, and the ethanol (95%) extract was inactive on *Staphylococcus aureus*[TT0165].

Anticholesterolemic activity. Saponin fraction of the dried root, administered by gastric intubation to rabbits at a dose of 10.0 mg/kg for 90 days, decreased the development of protein, carbohydrate, and lipid dystrophy of the liver vs cholesterol-loaded animals[TT0217].

Anticholinergic activity. The dried fruit, administered by gastric intubation to mice at a concentration of 5.0 mg/ml in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active on the ileum vs ACh-induced contractions[TT0154].

Antieczema effect. Decoction of the dried fruit, in a prescription containing *Ledebouriella seseloides*, *Clematis armandi*, *Rehmannia glutinosa*, *Paeonia albiflora*, *Lophatherum gracile*, *Dictamnus dascarpus*, *Glycyrrhiza glabra*, and *Schizonepeta tenuifolia*, taken orally by adults, was active[TT0119]. The entire plant, taken orally by 47 children in a double-blind, placebo-controlled study, was active[TT0117]. Decoction of the plant, at a dose of 200.0 ml/person in a preparation containing *Ledebouriella seseloides*, *Potentilla chinensis*, *Clematis armandii*, *Rehmannia glutinosa*, *Paeonia albiflora*, *Lophaterum gracile*, *Dictamnus dasycarpus*, *Glycyrrhiza glabra*, and *Schizonepeta tenuifolia*, was taken orally every day for 8 weeks. The treatment was effective on 40 adults with refractory atopic dermatitis[TT0128], and 31 patients with severe ectopic eczema[TT0122].

Antifilarial activity. Hot water extract of the plant, in a mixture with *Melia azadirachta* (15%), *Sida cordifolia* (15%), *Tribulus terrestris* (12%), *Terminalia chebula* (39%), and *Tinospora cordifolia* (19%), at a concentration of 100.0 mcg/ml, produced weak activity on *Acanthocheilonema viteae*. A concentration of 500.0 mcg/ml was active[TT0153].

Antihistamine activity. The dried fruit, at a concentration of 5.0 mg/ml in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active on the mouse ileum vs histamine-induced contractions. A dose of 1.0 gm/kg, administered by gastric intubation, was active vs histamine-induced pedal edema[TT0154].

Anti-inflammatory activity. Ethanol (95%) extract of the entire plant, administered orally to rats at a dose of 20.0 mg/kg, was inactive vs formalin-induced pedal edema [TT0142]. The dried fruit, administered by gastric intubation to mice at a dose of 2.0 gm/kg in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active vs dextran-induced pedal edema, leakage of dye into the peritoneal cavity and yeast-induced inflammation of the paw[TT0154]. The root, in a preparation (Rumalaya tablets, Himalaya Drug Co., India) containing *Pristimera indica*, *Rubia cordifolia*, *Tinospora cordifolia*, *Commiphora mukul*, and muskadena, was taken orally by 50 patients with rheumatoid arthritis. Pain and tenderness of the joints decreased in 28% of the subjects after 2 weeks of treatment. Thirty-two percent of the patients did not respond. No side effect was observed in the patients[TT0175].

Antimalarial activity. Ethanol (50%) extract of the dried fruit, administered intragastrically to mice at a dose of 1.0 gm/kg, was inactive on *Plasmodium berghei*. The methanol (50%) extract, at a concentration of 100.0 mcg/ml, produced 16% inhibition on *Plasmodium berghei*[TT0158].

Antimycobacterial activity. Chloroform extract of the dried entire plant, on agar plate, was active on *Mycobacterium phlei*, MIC 41.6 gm/liter. The methanol extract, at a concentration of 1.0 gm/liter, was inactive[TT0151].

Antipruritic activity. Ethanol (70%) extract of the plant, administered intragastrically to mice at a dose of 500 mg/kg, was inactive vs compound 48/80-induced pruritis[TT0118].

Antispasmodic activity. Ethanol (95%) extract of the dried fruit, at a concentration of 200.0 mcg/ml, was inactive on guinea pig ileum vs histamine-, and barium-induced contractions[TT0187]. Ethanol (95%) extract of the entire plant, at a concentration of 10.0 mcg/ml, was active on guinea pig ileum vs ACh-, histamine-, and $BaCl_2$-induced spasms[TT0142]. The alkaloid fraction and water extract of the dried fruit were active on the rat intestine vs ACh-induced contractions[TT0215].

Antitumor activity. Water extract of the dried fruit, at a dose of 100.0 mg/kg, was active on the mouse Sarcoma 180(ASC)[TT0148].

Antiurolithiasis activity. Ethanol (95%) extract of the dried fruit, administered intragastrically to rats at a dose of 25.0 mg/kg, was active vs seed-induced cystolithiasis[TT0126].

Antiyeast activity. Chloroform extract of the dried entire plant, on agar plate, was active on *Candida albicans*, MIC >83.2 gm/liter. The methanol extract, at a concentration of 1.0 gm/liter, was inactive[TT0151]. Ethanol (95%) and water extracts of the dried aerial part, on agar plate at concentrations of 100.0 mg/disc and 20.0 mg/disc, respectively, were inactive on *Candida albicans*[TT0165]. Hot water extract of the dried entire plant was active on *Candida albicans*[TT0155].

Aphrodisiac activity. The dried seed, in a preparation containing *Orchis mascula*, *Lactuca scariola*, *Hygrophila spinosa*, *Macuna pruriens*, *Parmelia parlata*, *Argyreia speciosa*, and *Laptadenia reticulata*, was taken by 21 infertile oligospermic patients in the age group of 25–35 years. The patients were administered 2 tablets, 3 times daily for 4 weeks. Fifty percent of the patients showed improvement of prostatic function as assessed by the activity of maltase and by the citric acid content, with increase in the activity of amylase and maltase, and a decrease in post-treatment levels of glycogen in seminal fluid. No marked change in seminal vesicular function was noted[TT0172]. The saponin fraction of the dried entire plant, administered by gastric intubation to male rats, increased sexual reflexes and libido. There was also an increase in libido when the saponin fraction was taken orally by men[TT0173].

Barbiturate potentiation. Methanol extract of the dried fruit, administered intraperitoneally to mice at a dose of 500.0 mg/kg, was inactive[TT0191]. The dried fruit, at a concentration of 5.0 mg/ml in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active[TT0154].

Benign prostatic hyperplasia improvement. Hot water extract of the dried entire plant, in a preparation that also contained *Orchis mascula*, *Lactuca serriola*, *Asteracantha longifolia*, *Macuna pruriens*, *Parmelia perlata*, *Argyreia speciosa*, *Leptadenia reticulata*, and gold, was taken orally by 45 patients with prostatitis and 10 patients serving as untreated controls. Of the 38 patients with benign hypertrophy in the test group, 28 improved and did not need surgery. All of the controls needed surgery[TT0204].

Cardiac depressant activity. Alkaloid fraction of the dried fruit was active on the frog heart[TT0215].

Cardiotonic activity. Water extract of the fruit was active on cat papillary muscle and frog and rabbit hearts[TT0120]. Ethanol (95%) extract of the entire plant, administered by perfusion at a concentration of 2.5 mg/animal, increased the rate and amplitude of frog heart[TT0142].

Cardiovascular effect. Ethanol (95%) extract of the dried entire plant decreased the force of contractions of rabbit heart[TT0182].

Cholinesterase inhibition. Ethanol (95%) extract of the entire plant, at a concentration of less than 0.5 mg/ml, was active on the rectus abdominus muscles of frogs[TT0142].

Chronotropic effect. Saponin fraction of the fresh aerial part, administered intravenously to rats, produced a negative chronotropic effect vs diosgenin[TT0224]. The dried fruit, administered intravenously to rats at a dose of 1.0 gm/kg in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, had a positive effect[TT0154].

Circulation stimulation. Water extract of the dried fruit, administered intravenously to rabbits at a dose of 4.5 mg/kg, was active[TT0197].

CNS depressant activity. Chloroform and ethanol (95%) extracts of the dried entire plant, administered intraperitoneally to mice at a dose of 500.0 mg/kg, were active[TT0146].

CNS stimulant activity. Ethanol (95%) extract of the entire plant, administered orally to rats at a dose of less than 50 mg/kg, was active[TT0142].

Convulsant activity. Ethanol (95%) extract of the entire plant, administered orally to rats at a dose of 50.0 mg/kg, produced clonic-type convulsions[TT0142].

Corticosteroid type activity. Ethanol (95%) extract of the entire plant, administered orally to fasted rats at a dose of 20.0 mg/kg, was active. The treatment also lowered the level of ascorbic acid in the adrenals[TT0142].

Cytotoxic activity. Ethanol (50%) extract of the entire plant, in cell culture, was inactive on CA-9KB, ED_{50} >20.0 mcg/ml[TT0103]. Water extract of the dried seed, in cell culture at a concentration of 500.0 mcg/ml, was inactive on CA-mammary-microalveolar cells[TT0157].

Diuretic activity. Alkaloid fraction of the dried fruit, taken orally by adults, produced weak activity. The ether extract, administered intravenously to anesthetized dogs, produced diuresis and increased the creatinine renal clearance, but had little effect on chloride clearance[TT0214]. Ethanol (95%) extract of the entire plant, administered orally to dogs at a dose of 20.0 mg/kg, was inactive[TT0142]. Ethanol (95%) extract of the seed, taken orally by adults, was active[TT0105]. Hot water extract of the plant, administered intraperitoneally to male rats at a dose of 0.2 ml/animal, was active. The duration of action was 60 minutes[TT0170].

Estrogenic effect. The saponin fraction of the dried entire plant was active when administered by gastric intubation to female rats[TT0173].

Fertility promotion effect. Tablets of the dried entire plant were administered to 35 patients with oligospermia at a dose of 192 mg/day for 3 months. The treatment produced an improvement in total sperm count and motility[TT0196]. The saponin fraction of the dried entire plant was active when administered by gastric intubation to female rats[TT0173].

Follicle stimulating hormone effect. The dried seed, in a preparation containing *Orchis mascula*, *Lactuca scariola*, *Hygrophila spinosa*, *Macuna pruriens*, *Parmelia parlata*, *Argyreia speciosa*, and *Laptadenia reticulata*, taken orally by adults at variable dosage levels, was equivocal on FSH release inhibition, release stimulation and synthesis stimulation[TT0172].

Glutamate pyruvate transaminase inhibition. Water extract of the seed, at a concentration of 1.0 mg/ml, was active on rat hepatocytes vs CCl_4-induced hepatotoxicity[TT0116].

Glycolate dehydrogenase inhibition. Decoction of the fruit, administered intragastrically to glycolate-challenged rats at a dose of 5.0 gm/kg, decreased oxylate and increased glyoxylate in the urine[TT0127].

Glycolate oxidase inhibition. Decoction of the fruit, administered intragastrically to glycolate-challenged rats at a dose of 5.0 gm/kg, decreased oxylate and increased glyoxylate in the urine[TT0127].

Gonadotropin effect. The dried seed, in a preparation containing *Orchis mascula*, *Lactuca scariola*, *Hygrophila spinosa*, *Macuna pruriens*, *Parmelia parlata*, *Argyreia speciosa*, and

Laptadenia reticulata, taken orally by adults at variable dosage levels, was equivocal on gonadotropin synthesis stimulation and release stimulation[TT0172].

Hemolytic activity. Saline extract of the dried seed, at a concentration of 10%, was active on human red blood cells[TT0188].

Hyperglycemic activity. Ethanol (95%) extract of the entire plant, administered orally to fasted rats at a dose of 20.0 mg/kg, was effective[TT0142].

Hypertensive activity. Hot water extract of the plant, administered intraperitoneally to male rats at a dose of 0.2 ml/animal, was active. The duration of action was 60 minutes[TT0170].

Hyperthermic effect. Ethanol (95%) extract of the dried entire plant, administered intraperitoneally to mice at a dose of 500.0 mg/kg, was inactive[TT0182].

Hypocholesterolemic activity. Ethanol (95%) extract of the entire plant, administered orally to fasted rats at a dose of 20.0 mg/kg, was effective[TT0142].

Hypooxyaluric effect. The dried fruit, administered intragastrically to rats at a dose of 5.0 gm/kg, was active vs hyperoxaluric condition induced by hydroxyproline and maintained by sodium glycolate[TT0123].

Hypotensive activity. Alkaloid fraction of the dried fruit, administered intravenously to dogs, was inactive. The water extract was active[TT0215]. Ethanol (95%) extract of the dried entire plant, administered intraperitoneally to mice and intravenously to rabbits at a dose of 500.0 mg/kg, was active[TT0182]. Ethanol (95%) extract of the entire plant, administered intravenously to cats at a dose of 20.0 mg/kg, produced a 20 to 50 mm/Hg drop in blood pressure for 3 to 5 minutes[TT0142]. A dose of 50.0 mg/kg, administered intravenously to dogs, was effective[TT0103].

Immunologic effect. The powdered plant, taken orally in combination with *Ledebouriella seseloides*, *Potentilla chinensis*, *Clematis armandii*, *Rehmannia glutinosa*, *Paeonia albiflora*, *Lophaterum gracile*, *Dictamnus dasycarpus*, *Glycyrrhiza glabra*, and *Schizonepeta tenuifolia*, was active vs increased soluble IL-2 receptor and vascular cell adhesion molecule in atopic eczema patients and interleukin 4-induced CD23 expression in atopic eczema patients. Eight weeks of treatment in atopic eczema patients decreased IgE complexes, while total IgE did not change[TT0132].

Inotropic effect (negative). Saponin fraction of the fresh aerial part, administered intravenously to rats, was active[TT0224].

Kidney stone dissolution effect. Ethanol (95%) extract of the dried entire plant, in combination with *Cucumis melo*, *Carum carvi*, *Pimpinella anisum*, *Zea mays*, *Foeniculum vulgare*, *Laurus nobilis*, and *Prunus avium*, was taken by 300 patients with kidney and ureteral stones. Sixty-seven percent of the patients passed stones, 18% transferred and there was a decrease in volume of stone in 11%. Ninety-eight percent of the patients reported relief from colic[TT0193].

Leukopenic activity. Ethanol (95%) extract of the dried fruit, administered intragastrically to rats at a dose of 50.0 mg/kg, was active[TT0126].

Luteinizing hormone effect. The dried seed, in a preparation containing *Orchis mascula*, *Lactuca scariola*, *Hygrophila spinosa*, *Macuna pruriens*, *Parmelia parlata*, *Argyreia speciosa*, and *Laptadenia reticulata*, taken orally by adults at variable dosage levels, was equivocal on LH release inhibition, release stimulation and synthesis stimulation[TT0172].

Molluscicidal activity. Water extract of the dried entire plant, at a concentration of 100.0 ppm, was active on *Bulinus truncatus*[TT0150].

Nematocidal activity. Decoction of the entire plant, at a concentration of 10.0 mg/ml, produced weak activity on *Toxacara canis*[TT0156]. Water extract of the dried fruit, at

a concentration of 10.0 mg/ml, was active on *Toxacara canis*. The methanol extract, at a concentration of 1.0 mg/ml, was inactive[TT0159].

Neurotoxic activity. The dried aerial part, in the ration of ewes at variable dosage levels, caused an unusual locomotory disturbance characterized by staggering[TT0195].

Penis erectile stimulant. The dried fruit, taken orally, produced an improvement in erection, duration of coitus and postcoital satisfaction in 56 cases treated for 4 weeks[TT0199].

Photosensitizing activity. The fresh aerial part, administered orally to sheep and goats, was active. There was a 37% prevalence in clinical cases in sheep[TT0206].

Respiratory depressant effect. Ethanol (95%) extract of the dried entire plant, administered intraperitoneally to mice at a dose of 500.0 mg/kg, was active[TT0182].

Respiratory stimulant effect. Ethanol (95%) extract of the entire plant, administered orally to dogs at a dose of 20.0 mg/kg, produced weak activity of a brief duration[TT0142].

Sclerosing effect. Saponin fraction of the dried leaf, administered intravenously to adults, was active. The biological activity has been patented[TT0184].

Skeletal muscle relaxant activity. Ethanol extract of the entire plant, at a concentration of 500.0 mcg/ml, was inactive on a frog rectus abdominus muscle[TT0142]. Ethanol (95%) extract of the dried entire plant, administered intraperitoneally to mice at a dose of 300.0 mg/kg, was active[TT0194].

Smooth muscle relaxant activity. Ethanol (95%) extract of the entire plant, at a concentration of 10.0 mcg/ml, was active on rabbit duodenum[TT0142]. The dried fruit, at a concentration of 5.0 mg/ml in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active on mouse ileum vs spontaneous and barium-induced contractions[TT0154].

Smooth muscle stimulant activity. Ethanol (95%) extract of the dried aerial part blocked atropine-induced contractions of guinea pig ileum[TT0182].

Spermatogenic affect. The dried seed, in a preparation containing *Orchis mascula*, *Lactuca scariola*, *Hygrophila spinosa*, *Macuna pruriens*, *Parmelia parlata*, *Argyreia speciosa*, and *Laptadenia reticulata*, was taken by 30 infertile oligospermic patients in the age group of 24 to 46 years. After 4 months of treatment, there were increases in magnesium content and in sperm count[TT0171]. The plant was taken orally in a mixture containing *Orchis mascula*, *Lactuca scariola*, *Hygrophila spinosa*, *Macuna pruriens*, *Parmelia parlata*, *Argyreia speciosa*, *Laptadenia reticulata*, and *Suvarnavang* (mosaic gold) by 40 adult males, most of whom showed marked improvement in semen profiles [TT0168]. The saponin fraction of the dried entire plant, taken orally by the adult male, was active[TT0173].

Toxic effect. The fresh aerial part, administered orally to sheep, produced a fatality rate of almost 70%[TT0206]. Toxicity was also indicated in lambs and goats[TT0149]. The aerial part, in the ration of ewes, did not cause Geeldikkop in black faced sheep[TT0223]. The fresh plant, administered intragastrically to lamb, produced nigrostriatal dopaminergic disorder[TT0147].

Toxicity assessment. Ethanol (95%) extract of the dried plant, in a mixture containing *Cucumis melo*, *Carum carvi*, *Pimpinella anisum*, *Zea mays*, *Foeniculum vulgare*, *Laurus nobilis*, and *Prunus avium*, administered intraperitoneally to mice, produced LD_{50} 7.0 ml/kg[TT0193]. Ethanol (95%) extract of the entire plant, administered intraperitoneally to rats, produced LD_{50} 56.4 mg/kg[TT0142]. The maximum tolerated dose of the ethanol (50%) extract when administered intraperitoneally to mice was 100.0 mg/kg[TT0103].

Tyrosinase inhibition. Methanol (50%) extract of the dried fruit, at a concentration of 100.0 mg/ml, was inactive[TT0169].

Uterine stimulant effect. Water extract of the seed was inactive on a nonpregnant rat uterus[TT0102].

Vasodilator activity. The dried fruit, at a concentration of 5.0% in a preparation containing *Bombyx mori*, *Aconitum sinense*, *Alpinia* species, *Mentha arvensis*, and *Sophora flavescens*, was active on rabbit atrium[TT0154].

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24 Vitex agnus-castus

L.

Common Names

Abrahamsstraugh	Europe	Hayit	Turkey
Agno-casto	France	Hemp tree	India
Agnus castus	Iran	Jurema	Brazil
Angarf	Morocco	Kef-meriem	France
Banjankusht	Arabic countries	Kerwa	Morocco
Chaste tree	Croatia	Keuschlamm	Europe
Chaste tree	Europe	Monchpfeffer	Europe
Chaste tree	India	Monk's pepper tree	Iran
Chaste tree	France	Monk's pepper tree	India
Chaste tree	Germany	Panj angosht	Iran
Chaste tree	Iran	Ranukabija ma	India
Cyclamen	Arabic countries	Sauzatillo	France
Felfele barry	Iran	Tree of chastity	Iran
Gattilier	France		

BOTANICAL DESCRIPTION

A strongly aromatic shrub or low tree of the VERBENACEAE family with densely short-puberulent branches. The leaves, 5–9, are digitate and velvety. Leaflets, 5–7, are mostly unequal, the central one largest, the lowermost pair smallest, the 3 largest petiolulate, the 2–4 smallest usually sessile, and narrow-elliptical, the central one 4.5–11.5 cm long and 9–21 mm wide, attenuate or acuminate at both ends, pulverulent or glabrate above. Petioles 1.5–2.5 cm long are densely puberulent and resinous-granular. Flowers are pale purple or violet, in interrupted spikes, in groups of several. Drupes are small, 4-celled, globose and exceeding the calyx.

ORIGIN AND DISTRIBUTION

Native to Southern Europe and the Orient, it is widely cultivated and now naturalized in most of the Eastern and Southern United States, and in the tropics and warm temperate regions of both hemispheres.

TRADITIONAL MEDICINAL USES

Arabic countries. The dried seed is taken orally as a lactogenic agent and emmenagogue. The hot water extract is used as a contraceptive, and the entire plant is inhaled,

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By: Ivan A. Ross Humana Press Inc., Totowa, NJ

by fumigation, as an emmenagogue in Unani medicine[VA0140].

Austria. The fruit is eaten as an emmenagogue and an aphrodisiac[VA0112].

Europe. Hot water extracts of the entire plant and the fruit are taken orally as an emmenagogue, anaphrodisiac, and to promote expulsion of the afterbirth[VA0146].

France. Hot water extracts of the flowering top and leaf, and of the fruit are taken orally as an antispasmodic, sedative, and anaphrodisiac[VA0145]. Hot water extract of the dried fruit is taken orally as an antispasmodic and for an antiestrogenic effect[VA0137].

Germany. Tincture of the fruit is taken orally for menorrhagia[VA0100].

Iran. Infusion of the dried fruit is taken orally as an anaphrodisiac, tonic, diuretic, antiflatulent and narcotic[VA0107].

Morocco. The seed is taken orally as a calefacient[VA0127].

CHEMICAL CONSTITUENTS

(ppm unless otherwise indicated)

Abietatriene: Fr EO 0.44%[VA0131]
Agnuside: Lf 0.3-0.6%[VA0148,VA0133], Wd[VA0105], Fr, Pl[VA0112], Sd[VA0153]
Alcohol, diacetyl: Fr EO 0.29%[VA0131]
Androstenedione: Lf[VA0136]
Anethole: Fr EO 0.77%[VA0131]
Aromadendrene, allo: Lf EO 3.4-8.6%[VA0109], Fr EO 0.79-8.8%[VA0126,VA0120], Fl EO 0.99%[VA0126]
Artemetin: Fr 12.5[VA0106]
Artemiseol: Lf EO 0.1%, Fr EO, Fl EO 0.1%[VA0108]
Aucubin: Wd[VA0105], Lf 0.4%[VA0148], Fr, Pl[VA0112]
Aucuboside: Fr, Lf[VA0153], Sd[VA0153]
Benzofuran: Fr EO 0.4%[VA0120]
Bergamotene, alpha, cis: Fr EO 1.09%[VA0131]
Bergamotene, alpha, trans: Fr EO 0.8%, Lf EO 0.7%, Fl EO 0.6%[VA0108]
Beyerene: Fr EO 1.85%[VA0131]
Bisabolol, alpha, epi: Fr EO 0.2%, Fl EO 0.3%, Lf EO 0.3%[VA0108]
Bisabolol, beta: Fr EO 0.32%[VA0131]
Borneol acetate: Fl EO 0.1%, Lf EO 0.1%, Fr EO 0.8%[VA0108]
Cadina-5,10(15)-dien-4-ol: Fr EO 1.18%[VA0131]
Cadinene, delta: Fl EO 0.6%, Lf EO 0.5%, Fr EO 0.4%[VA0108]
Cadinene, gamma: Fr EO 0.1%[VA0120], Lf EO 0.1%[VA0109]
Cadinol, alpha: Fl EO, Lf EO 0.1%, Fr EO 1.4%[VA0108]
Cadinol, delta: Fr EO 0.15%[VA0131]
Cadinol, T: Lf EO 0.1-1.2%[VA0109,VA0108], Fr EO 0.21-2.82%[VA0126,VA0131], Fl EO 2.09%[VA0126]
Camphene: Lf EO, Fr EO 0.1%, Fl EO[VA0108]
Campholenal, alpha: Lf EO[VA0109]
Camphor: Lf EO 0.15%[VA0126], Fr EO 0.12-0.24%[VA0131,VA0126], Fl EO 0.16%[VA0126]
Car-3-ene: Lf EO 0.3%, Fr EO 0.1%[VA0108]
Carveol, cis: Lf EO 0.1%, Fr EO 0.3%[VA0108]
Carvone, cis-dihydro: Fr EO, Fl EO 0.3%[VA0108]
Carvone, trans-dihydro: Fl EO 0.1%, Fr EO 0.1%[VA0108]
Caryophyllene epoxide: Fr EO 1.76%[VA0131]
Caryophyllene oxide: Lf EO 0.3-1.17%[VA0109,VA0126], Fr EO 0.1-5.52%[VA0120,VA0126], Fl EO 4.86%[VA0126]
Caryophyllene, beta: Fl EO 8.4%[VA0126], Fr EO 0.91-11.76%[VA0126,VA0131], Lf EO 3.9-8.9%[VA0109,VA0108]
Caryophyllene: Fr EO 4.8%[VA0120]
Casticin: Fr[VA0112], Lf[VA0132], Sd 0.1%[VA0150]
Cedrane-8(s)-14-diol: Fr EO 0.64%[VA0131]
Chrysosplenetin: Fr 1.2[VA0106]
Chrysosplenol, D: Fr[VA0138]
Cineol, 1-8: Fr EO 0.15-20.6%[VA0131,VA0108], Lf EO 11.21-35.2%[VA0126,VA0109], Fl EO 6.09%[VA0126]
Cinnamaldehyde: Lf EO[VA0108]
Citronellol acetate: Fr EO 0.2%[VA0108], Lf EO 0.2-0.5%[VA0109]
Citronellol: Fr EO 0.1-1.0%[VA0120,VA0108], Lf EO 0.1-0.9%[VA0109,VA0108]
Cuminaldehyde: Lf EO 0.1%[VA0109]
Cuparene: Fr EO 0.2%, Lf EO[VA0108]
Curcumene, alpha: Fr EO 0.32%[VA0131]
Cymene, para: Lf EO 0.2-1.4%[VA0109,VA0126], Fr EO 1.13-3.18%[VA0131,VA0126], Fl EO 2.1%[VA0126]
Cymol, ortho: Lf EO[VA0134]
Cynaroside: Lf[VA0112]
Dodec-1-ene: Lf EO 0.3%, Fr EO 0.1%, Fl EO 0.4%[VA0108]

Dodecane, n: Lf EO 1.0%, Fr EO 0.1%, Fl EO 0.8%[VA0108]
Elemene, gamma: Lf EO 0.1%[VA0109]
Encecalin, demethoxy: Fr EO 1.35%[VA0131]
Ethanol, 2-butoxy: Fr EO 0.36%[K29804]
Eugenol: Lf EO 0.3%[VA0108]
Eurostoside: Lf 700[VA0133]
Farnesene, beta, cis: Lf EO 8.6%[VA0108], Fr EO 1.77-6.90%[VA0131,VA0108]
Farnesene, beta, trans: Lf EO 8.15%, Fl EO 5.24%[VA0126], Fr EO 0.4-1.67%[VA0108,VA0126]
Farnesene, beta: Lf EO 3.4-8.6%[VA0109]
Geranial: Lf EO 0.2%, Fr EO 0.3%[VA0108]
Geraniol acetate: Fr EO 0.2%[VA0108]
Geraniol: Lf EO 0.5%, Fr EO 0.6%[VA0108]
Germacrene B: Fr EO 8.1-9.4%[VA0120,VA0131], Lf EO 0.7-11.2%[VA0109]
Globulol: Fr EO 0.2-0.6%[VA0108,VA0131], Lf EO 0.1-0.5%[VA0109]
Guaiacol: Fr EO 0.3%[VA0120]
Guaiene, alpha: Fr EO 1.0%, Lf EO 1.0%[VA0108]
Guaiol: Lf EO 1.3%, Fr EO 1.0%[VA0108]
Gurjunene, alpha: Lf EO 0.3-1.6%[VA0108,VA0109], Fr EO 0.2-1.0%, Fl EO 0.31%[VA0126]
Gurjunene, beta: Fr EO 0.18-0.50%[VA0108,VA0131], Lf EO 0.3%[VA0108]
Gurjunene, gamma: Fr EO 0.1%[VA0120], Lf EO[VA0109]
Heptan-1-ol: Fr EO 800[VA0131]
Hexacosane, n: Fr EO 0.1%[VA0120]
Hexadec-1-ene: Lf EO 0.1%, Fr EO: 0.1%[VA0108]
Humulene, alpha: Fr EO[VA0108], Lf EO 0.6-0.8%[VA0108,VA0131]
Kaempferol, 6-hydroxy 3,4,6,7-tetramethyl ether: Fr[VA0112,VA0138]
Kaempferol, 6-hydroxy 3,6,7-trimethyl ether: Fr[VA0138]
Kaurene: Lf EO 0.6%[VA0108]
Ledol: Lf EO 0.6%[VA0108], Fr EO 0.27-0.80%[VA0108,VA0131], Fl EO 1.18%[VA0126]
Limonene: Fr EO 0.5-16.7%[VA0108,VA0120], Lf EO 0.5-11.21%[VA0108,VA0126], Fl EO 6.09%[VA0126]
Linalool acetate: Lf EO 0.2%[VA0108], Fr EO 0.3%[VA0108]
Linalool: Fr EO 0.1-0.9%[VA0120,VA0108], Lf EO 0.1-0.7%[VA0109,VA0108]
Longifolene: Lf EO 0.2%, Fr EO 0.1%[VA0108]
Luteolin: Fr 5.5[VA0106]
Luteolin-6-C-(4-methyl-6-O-trans-caffeoyl-glucoside): Fr 23[VA0106]
Luteolin-6-C-(6-O-trans-caffeoyl-glucoside): Fr 6.5[VA0106]
Luteolin-6-C-(trans-caffeoyl-glucoside): Fr 16[VA0106]
Luteolin-7-O-(6-para-benzoyl-glucoside): Fr 1.2[VA0106]
Manool oxide: Fr EO 1.7%[VA0120]
Manool, 13-epi: Fr EO 1.01%[VA0120], Lf EO 0.1-0.8%[VA0109]
Manool, beta, epi: Lf EO, Fr EO[VA0108]
Manool: Fr EO 0.35-0.90% [VA0131,VA0108], Lf EO 1.3%[VA0108]
Manoyl oxide: Lf EO 0.1-0.5%[VA0109], Fr EO[VA0108]
Menth-cis-2-en-1-ol, para: Fr EO 0.4[VA0120], Lf EO 0.1-0.9%[VA0109,VA0108]
Menthol: Fr EO 0.14%[VA0131]
Menth-trans-2-en-1-ol, para: Fr EO 0.1-0.3%[VA0108,VA0120], Lf EO 0.1-0.7%[VA0108,VA0109]
Muurolene, alpha: Lf EO 0.3%[VA0108]
Muurolene, gamma: Lf EO 0.3%, Fr EO 0.6%[VA0108]
Muurolot, T: Lf EO[VA0109]
Myrcene, beta: Fr EO 1.12%[VA0131]
Myrcene: Fr EO 0.74%[VA0126], Lf EO 0.1-1.8%[VA0109,VA0126], Fl EO 1.03%[VA0126]
Nerol acetate: Fr EO 0.2%[VA0108]
Nerol: Lf EO 0.3%, Fr EO 0.4%[VA0108]
Nerolidol, cis: Lf EO 0.1%, Fr EO 0.2%[VA0108]
Nerolidol: Fr EO 0.17%[VA0131]
Nonal-1-al: Lf EO 0.15%, Fr EO 0.2%[VA0108]
Ocimene, beta, cis: Lf EO, Fr EO 0.1%[VA0108]
Ocimene, beta, trans: Fr EO, Lf EO 0.15%[VA0108]
Octacosane, N: Fr EO 0.1%[VA0120]
Octadec-1-ene: Fr EO 0.2%[VA0108]
Octan-3-ol-acetate: Fr EO 0.26%[VA0131]
Orientin, iso: Lf, St[VA0149]
Orientin: Lf[VA0112,VA0132]
Penduletin: Fr[VA0112]
Phellandrene, alpha: Lf EO 0.2-0.8%, Fr EO 0.5%[VA0108]
Phellandrene, beta: Fr EO 5.6%[VA0131], Lf EO 0.1%[VA0108]
Phenol, 4-vinyl: Fr EO 0.1%[VA0120]
Phenol: Fr EO 1.1%[VA0120]

Phenylacetaldehyde: Fr EO 0.4%[VA0108]
Phyllocladene: Lf EO 0.1%[VA0108]
Pinene, alpha: Lf EO 0.7-7.6%[VA0109], Fr EO 3.5-7.5%[VA0120,VA0131], Fl EO 2.01%[VA0126]
Pinene, beta: Lf EO 0.98-2.4%[VA0126,VA0108], Fl EO 0.46%[VA0126], Fr EO 0.47-1.5%[VA0108,VA0131]
Pinene, cis, hydrate: Lf EO[VA0109]
Pinocarveol, trans: Lf EO[VA0109]
Piperitol, cis: Fr EO 0.28%[VA0131], Lf EO 0.1%[VA0108]
Piperitol, trans: Lf EO, Fr EO 0.2%[VA0108]
Piperitone: Fr EO 0.84%[VA0131]
Progesterone, 17-alpha-hydroxy: Lf[VA0136]
Progesterone: Lf[VA0136]
Propionaldehyde, 2-phenyl: Lf EO[VA0109]
Rhamnetin, iso: Fr 0.85[VA0106]
Rubber: Rt 110[VA0147]
Sabinene, cis, hydrate: Lf EO 0.3%, Fr EO 0.2%[VA0108]
Sabinene, trans, hydrate: Lf EO, Fr EO 0.1%[VA0108]
Sabinene: Fl EO 9.34%[VA0126], Lf EO 3.3-23.6%[VA0109], Fr EO 7.1-22.3%[VA0108,VA0126]
Santalol, alpha: Fr EO, Lf EO 0.1%[VA0108]
Sclareol: Fr EO 0.2-1.28%[VA0108,VA0131], Lf EO 0.3%[VA0108]
Selinene, beta: Lf EO 9.0%, Fr EO 6.0%[VA0108]
Sesquiphellandrene, beta: Fr EO 0.54%[VA0131]
Spathulenol: Lf EO 0.2-1.16%[VA0109,VA0126], Fr EO 0.4-3.83%[VA0120,VA0126], Fl EO 3.84%[VA0126]
Terpinen-4-ol acetate: Lf EO 0.1%, Fr EO 0.2%[VA0108]
Terpinen-4-ol: Lf EO 0.1-3.82%[VA0109,VA0126], Fr EO 2.2%[VA0108]
Terpinene, alpha: Fr EO 0.52%[VA0131], Lf EO0.2%[VA0108]
Terpinene, gamma: Fr EO 0.22-0.92%[VA0126,VA0131], Lf EO 0.21-1.1%[VA0126,VA0108], Fl EO 0.1%[VA0126]
Terpineol, 4: Fr EO 0.1%[VA0120]
Terpineol, alpha, acetate: Lf EO 0.3-17.1%[VA0108,VA0109], Fl EO 3.29%[VA0126], Fr EO 0.1-7.7%[VA0108,VA0120]
Terpineol, alpha: Fr EO 0.7-5.5%[VA0131,VA0108], Lf EO 0.5-8.5%[VA0109,VA0108], Fl EO 1.17%[VA0126]
Terpineol, beta, acetate: Fr EO 0.09%[VA0131]
Terpineol, beta, cis: Lf EO, Fr EO 0.1%[VA0108]
Terpineol, delta: Lf EO 0.45%[VA0126]
Terpineol, trans, dihydro: Lf EO 0.1%[VA0109], Fr EO 0.19%[VA0131]
Terpineol, trans-alpha-dihydro: Lf EO 1.8%, Fr EO 1.3%[VA0108]
Terpinolene, alpha: Fr EO 0.24%[VA0131]
Terpinolene: Lf EO 0.4%, Fr EO 0.3%[VA0108]
Testosterone, epi: Fl[VA0136]
Testosterone: Fl[VA0136]
Tetracosane. N: Fr EO 0.1%[VA0120]
Tetracosanoic acid methyl ester: Fr EO[VA0120]
Tetradec-1-ene: Fr EO 0.2%[VA0108]
Thujene, alpha: Fr EO 0.1-0.5%[VA0120,VA0126], Fl EO 0.30%[VA0131], Lf EO 0.2-0.79%[VA0108,VA0126]
Thymol: Fr EO 0.47%[VA0131], Lf EO 0.1%[VA0108]
Tridecane, N: Fl EO 0.3%[VA0108]
Undec-1-ene: Fl EO 0.1%[VA0108]
Undecane, N: Lf EO 0.15%[VA0108]
Verbenol, trans: Lf EO[VA0109]
Viridiflorol: Lf EO 0.4%[VA0108], Fr EO 0.3-1.65%[VA0131,VA0108]
Vitexin, iso, xyloside: Lf[VA0112]
Vitexin, iso: Lf[VA0112]
Ylangene, alpha: Lf EO 0.3%, Fr EO 0.2%[VA0108]
Zingiberene, alpha: Fr EO 0.15%[VA0131]

PHARMACOLOGICAL ACTIVITY AND CLINICAL TRIALS

Anti-acne activity. Tincture of the dried fruit, taken orally by female adults at a dose of 1.0 ml/person 3 times daily, was active[VA0115].

Antibacterial activity. The essential oil and ethanol (95%) and ether extracts of the dried flower, leaf, and fruit, on agar plate, were active on *Bacillus subtilis*, *Escherichia coli*, and *Shigella sonnei*[VA0144]. The fruit essential oil, on agar plate, was active on *Escherichia coli* and *Staphylococcus aureus*[VA0134]. The leaf essential oil, on agar plate, was inactive on *Bacillus cereus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*[VA0143].

Antifertility effect. The seed, in the ration of rats of both sexes at a dose of 20.0 gm/kg, was inactive[VA0101].

Antifungal activity. Acetone, water and ethanol (95%) extracts of the dried aerial parts, on agar plate at a concentration of 50%, were active on *Neurospora crassa*[VA0152]. The essential oil, on agar plate, was active on *Candida albicans*[VA0144], and inactive on *Penicillium cyclopium*, *Trichoderma viride*, and *Aspergillus aegyptiacus*[VA0139]. Ethanol/water (1:1) extract of the dried fruit, on agar plate at a concentration of 500.0 mg/ml, was active on *Fusarium oxysporum*, and inactive on *Aspergillus fumagitus*, *Aspergillus niger*, *Botrytis cinerea*, *Penicillium digitatum*, *Rhizopus nigricans*, and *Trichophyton mentagrophytes*[VA0142]. The leaf essential oil, on agar plate, was inactive on *Aspergillus aegyptiacus*, *Penicillium cyclopium*, and *Trichoderma viride*[VA0143].

Anti-PMS activity. The dried fruit, at a dose of 20 mg daily for 3 months, was taken orally by 37 patients with luteal phase defects due to latent hyperprolactinaemia in a randomized, double-blind, placebo-controlled study. The treatment reduced the level of prolactin; luteal phase and progesterone synthesis were normalized in the treated group. No side effects were observed[VA0129]. The fruit was taken orally by 217 female patients for 3 months in a double-blind, placebo-controlled clinical study. The patients were treated with *Vitex agnus-castus* or a soy-based placebo. No statistical difference between the treatments was observed. However, both treatments indicated dramatic improvement after 1 cycle[VA0128].

Antiyeast activity. Acetone and ethanol (95%) extracts of the dried aerial parts, in broth culture at a concentration of 50%, were inactive on *Saccharomyces cerevisiae*[VA0151]. Ethanol/water (1:1) extract of the dried fruit, on agar plate at a concentration of 500.0 mg/ml, was inactive on *Saccharomyces pastorianus* and *Candida albicans*[VA0142]. Ether and ethanol (95%) extracts of the dried flower, leaf, and fruit, on agar plate, were active on *Candida albicans*[VA0144]. The fruit essential oil, on agar plate, was active on *Candida albicans*[VA0134].

Cytotoxic activity. Hydro-alcoholic extract of the dried fruit, in cell culture at a concentration of 3.3 mg/ml, was inactive vs cultured pituitary cells[VA0118].

Dopaminergic effect. Hydro-alcoholic extract of the dried fruit, in cell culture at a concentration of 2.0 mg/ml, was active. The extract bound to dopamine receptors and inhibited prolactin release[VA0118].

Fertility promotion effect. After 3 endocrinologically normal cycles, and after undergoing unstimulated invitro fertilization, a woman took the dried fruit at the beginning of the fourth unstimulated cycle. In the fourth cycle, her serum gonadotrophin and ovarian hormone measurements were disordered. One embryo resulted from the 3 eggs collected, but a pregnancy did not take place. The patient had symptoms suggestive of mild ovarian hyperstimulation syndrome in the luteal phase. The 2 subsequent cycles were endocrinologically normal[VA0111]. Multiple follicular development occurred in a patient treated with the plant[VA0119].

FSH release inhibition. Ethanol (16%) extract of the fruit, administered orally to guinea pigs for 90 days, was active[VA0100].

LH release stimulation. Ethanol (16%) extract of the fruit, administered orally to guinea pigs for 90 days, was active[VA0100].

Luteotropic effect. The fruit, taken orally by female adults at variable dosages, was active[VA0112].

Molluscicidal activity. Ethanol (80%) extract of the dried leaf, at a concentration of 200.0 mg/liter, was inactive on *Biomphalaria pfeifferi* and *Bulinus truncatus*[VA0135]. Water saturated with the fresh leaf essential oil, at a concentration of 1/10, was inactive on *Biomphalaria glabrata*[VA0141].

Premenstrual syndrome treatment. Hydro-alcoholic extract of the fruit was taken by women with premenstrual tension syndrome

over a period of 3 treatment cycles. In a randomized, controlled trial vs pyridoxine, a *Vitex agnus-castus* (VAC) capsule plus a placebo capsule is taken daily vs 2 capsules of pyridoxine (B6). The therapeutic response was assessed using the premenstrual tension syndrome scale (PMTS), the recording of 6 characteristic complaints of the syndrome and the clinical global impression scale (CGIS). Upon completion of the trial, efficacy of the treatment was assessed by the investigator as well as by the patient. On the PMTS, treatment with the VAC and B6 produced a reduction on score points from 15.2 to 5.1 and from 11.9 to 5.1, respectively. In comparison with B6, VAC produced a considerably more marked alleviation of typical PMTS complaints, such as tenderness of the breasts, edema, inner tension, headache, constipation and depression. Analogous results were obtained with the GCIS. In both treatment groups, efficacy was rated as inadequate by more than 80% of the investigators; however, VAC treatment rated as excellent by 24.5%, and B6 treatment by 12.1% of the investigators. According to the patient's assessment, 36.1% of the cases in the VAC group and 21.3% in the pyridoxine group were free from complaints. Adverse effects, such as gastrointestinal and lower abdominal complaints, skin manifestations, and transitory headache occurred in 5 patients under B6 and 12 patients under VAC[VA0121]. The fruit, taken orally by female adults at variable dosage levels, was active[VA0112]. Tincture of the dried fruit, taken orally by female adults at a dose of 0.2–9.0 ml/person, was active[VA0117].

Progestagenic effect. The seed oil was active on female rats[VA0104].

Prolactin inhibition. Hydro-alcoholic extract of the dried fruit, in cell culture at a concentration of 3.3 mg/ml, inhibited prolactin release induced by TRH in pituitary cells. Intravenous administration to rats, at a dose of 20.0 mg/ml, was active vs hypothalamus-lesioned animals. A dose of 60 mg/ml, administered intravenously to male rats, inhibited stress-induced prolactin release[VA0118].

Toxic effect. A 45-year-old woman suffered 3 general tonic-clonic seizures after taking black cohosh root, chaste tree berries and evening primrose oil. The patient recovered after discontinuing the herbal therapy and was prescribed carbamazepine[VA0110].

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Cross Reference

Common name	Country	Latin binomial
Aamudamu chettu	India	*Ricinus communis*
Aamudamu	India	*Ricinus communis*
Aavanak	India	*Ricinus communis*
Abrahamsstraugh	Europe	*Vitex agnus-castus*
Abrojo	Peru	*Tribulus terrestris*
Acetilla	Mexico	*Tanacetum parthenium*
Ach	India	*Morinda citrifolia*
Achi	Fiji	*Morinda citrifolia*
Achu	India	*Morinda citrifolia*
Adam's apple	Iran	*Musa sapientum*
Adam's fig	Iran	*Musa sapientum*
Agaliva	Guam	*Ricinus communis*
Agno-casto	France	*Vitex agnus-castus*
Agnus castus	Iran	*Vitex agnus-castus*
Ainshi	India	*Morinda citrifolia*
Akanti	India	*Tribulus terrestris*
Al	India	*Morinda citrifolia*
Alauro	Italy	*Laurus nobilis*
Alcanfor	Mexico	*Eucalyptus globulus*
Alfinetes de Senhora	Madeira	*Tanacetum parthenium*
Alipiong	India	*Ananas comosus*
Alloro	Italy	*Laurus nobilis*
Altamisa Mexicana	Mexico	*Tanacetum parthenium*
Altamisa	Argentina	*Tanacetum parthenium*
Altea	France	*Althaea officinales*
Altea	Peru	*Althaea officinales*
Althea	USA	*Althaea officinales*
Amaranon	Cuba	*Anacardium occidentale*
Ambal	India	*Nelumbo nucifera*

From: Medicinal Plants of the World, vol. 2: *Chemical Constituents, Traditional and Modern Uses*
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Common name	Country	Latin binomial
Ambuja	India	*Nelumbo nucifera*
American coneflower	USA	*Echinacea angustifolia*
Amudamu	India	*Ricinus communis*
Anana	Peru	*Ananas comosus*
Ananas	Dominica	*Ananas comosus*
Ananas	Fiji	*Ananas comosus*
Ananas	French Guiana	*Ananas comosus*
Ananas	Gabon	*Ananas comosus*
Ananas	Guadeloupe	*Ananas comosus*
Ananas	India	*Ananas comosus*
Ananas	West Indies	*Ananas comosus*
Ananash	India	*Ananas comosus*
Anannas	India	*Ananas comosus*
Anannasa	India	*Ananas comosus*
Anaras	India	*Ananas comosus*
Andela	Nepal	*Ricinus communis*
Ander	Nepal	*Ricinus communis*
Andras	Fiji	*Ananas comosus*
Angan-tangan	Philippines	*Ricinus communis*
Angarf	Morocco	*Vitex agnus-castus*
Anino	Philippines	*Morinda citrifolia*
Anis vert	France	*Pimpinella anisum*
Anis vert	Tunisia	*Pimpinella anisum*
Anisa	India	*Pimpinella anisum*
Anise seed	Guyana	*Pimpinella anisum*
Anise seed	Japan	*Pimpinella anisum*
Anise seed	Trinidad	*Pimpinella anisum*
Anise seed	West Indies	*Pimpinella anisum*
Anise seed	Yugoslavia	*Pimpinella anisum*
Anise	Argentina	*Pimpinella anisum*
Anise	Colombia	*Pimpinella anisum*
Anise	Guatemala	*Pimpinella anisum*
Anise	Mexico	*Pimpinella anisum*
Anise	Peru	*Pimpinella anisum*
Anise	USA	*Pimpinella anisum*
Anisoon	Arabic countries	*Pimpinella anisum*
Annesella	Italy	*Pimpinella anisum*
Apollo's laurel	France	*Laurus nobilis*
Ara kai	Cook Islands	*Ananas comosus*
Arand	Fiji	*Ricinus communis*
Arandi	India	*Ricinus communis*
Arq sus	Morocco	*Glycyrrhiza glabra*
Artemijio	Brazil	*Tanacetum parthenium*
Artemisia	Costa Rica	*Tanacetum parthenium*
Artemisia	Madeira	*Tanacetum parthenium*

Common name	Country	Latin binomial
Artmija	Madeira	*Tanacetum parthenium*
Arundi	Oman	*Ricinus communis*
Asat sinda musa	Morocco	*Laurus nobilis*
Asloosoos	India	*Glycyrrhiza glabra*
Avend	Nepal	*Ricinus communis*
Awl tree	Thailand	*Morinda citrifolia*
Awriwra	Morocco	*Ricinus communis*
Azad dirakhat	India	*Azadirachta indica*
Baalehannu	India	*Musa sapientum*
Babounag	Egypt	*Matricaria chamomilla*
Babunaj	Arabic countries	*Matricaria chamomilla*
Babunj	Tunisia	*Matricaria chamomilla*
Bachati	Nicaragua	*Matricaria chamomilla*
Badian	Afghanistan	*Pimpinella anisum*
Badian	India	*Pimpinella anisum*
Badishep	India	*Pimpinella anisum*
Baino	Cambodia	*Nelumbo nucifera*
Bakhra	India	*Tribulus terrestris*
Balambaal olyo	Somalia	*Ricinus communis*
Balamball	Somalia	*Ricinus communis*
Balsana	Arabic Countries	*Hypericum perforatum*
Balsana	India	*Hypericum perforatum*
Banana matenten	Haiti	*Musa sapientum*
Banana	Bahamas	*Musa sapientum*
Banana	China	*Musa sapientum*
Banana	Guyana	*Musa sapientum*
Banana	Japan	*Musa sapientum*
Banana	Philippines	*Musa sapientum*
Banana	USA	*Musa sapientum*
Banana	West Indies	*Musa sapientum*
Banjankusht	Arabic countries	*Vitex agnus-castus*
Bardul Khatmi	India	*Althaea officinales*
Barge boo	Iran	*Laurus nobilis*
Bartundi	India	*Morinda citrifolia*
Basal	Jordan	*Allium cepa*
Basal	Yemen	*Allium cepa*
Basl	Arabic Countries	*Allium cepa*
Basl	Saudi Arabia	*Allium cepa*
Bassal	Egypt	*Allium cepa*
Bassant	India	*Hypericum perforatum*
Bastitaj	India	*Tribulus terrestris*
Bay laurel	Japan	*Laurus nobilis*
Bay laurel	USA	*Laurus nobilis*
Bay tree	Europe	*Laurus nobilis*
Bay tree	Guyana	*Laurus nobilis*

Common name	Country	Latin binomial
Bay tree	Iran	*Laurus nobilis*
Bay tree	Japan	*Laurus nobilis*
Bay tree	USA	*Laurus nobilis*
Bay tree	West Indies	*Laurus nobilis*
Bay	Brazil	*Laurus nobilis*
Bay	Japan	*Laurus nobilis*
Bele ni vavalagi	Somalia	*Ricinus communis*
Bengkudu	Indonesia	*Morinda citrifolia*
Bermuda onion	USA	*Allium cepa*
Besbasa	Morocco	*Myristica fragrans*
Betagokhru	India	*Tribulus terrestris*
Bewina mara	India	*Azadirachta indica*
Bhakra	India	*Tribulus terrestris*
Bhakra	Pakistan	*Tribulus terrestris*
Bhasinda	India	*Nelumbo nucifera*
Bherenda	India	*Ricinus communis*
Black sampson	USA	*Echinacea angustifolia*
Black susans	USA	*Echinacea angustifolia*
Blutkraut	Germany	*Hypericum perforatum*
Bo-aal	India	*Morinda citrifolia*
Bofareira	USA	*Ricinus communis*
Bon visclo	France	*Althaea officinales*
Bo-nim	India	*Azadirachta indica*
Boucage anis	North Africa	*Pimpinella anisum*
Bouesc-dous	France	*Glycyrrhiza glabra*
Boulet	France	*Tanacetum parthenium*
Bouton d'argent	France	*Tanacetum parthenium*
Bsal	Morocco	*Allium cepa*
Bua luang	Thailand	*Nelumbo nucifera*
Bullhead	Kuwait	*Tribulus terrestris*
Burra gookeron	Kuwait	*Tribulus terrestris*
Buyan	Turkey	*Glycyrrhiza glabra*
Caju	Brazil	*Anacardium occidentale*
Caju	Portugal	*Anacardium occidentale*
Cajueiro	Brazil	*Anacardium occidentale*
Calamido	France	*Matricaria chamomilla*
Calipso	Italy	*Eucalyptus globulus*
Caliptus	Spain	*Eucalyptus globulus*
Calthrop	India	*Tribulus terrestris*
Caltrap	India	*Tribulus terrestris*
Caltrop	Australia	*Tribulus terrestris*
Caltrop	Kuwait	*Tribulus terrestris*
Camamieri	France	*Tanacetum parthenium*
Camamilla	Spain	*Matricaria chamomilla*
Camomiha	France	*Matricaria chamomilla*

Common name	Country	Latin binomial
Camomile	Germany	*Matricaria chamomilla*
Camomilla comune	Italy	*Matricaria chamomilla*
Camomilla	Colombia	*Matricaria chamomilla*
Camomilla	France	*Tanacetum parthenium*
Camomilla	Italy	*Matricaria chamomilla*
Camomirra	Italy	*Matricaria chamomilla*
Camoumida	France	*Tanacetum parthenium*
Campomilla	Italy	*Matricaria chamomilla*
Camsumilha	France	*Tanacetum parthenium*
Canamelha	France	*Tanacetum parthenium*
Cape lilac	Indonesia	*Azadirachta indica*
Carapate	Guadeloupe	*Ricinus communis*
Carrapateira	Brazil	*Ricinus communis*
Cashew apple	Brazil	*Anacardium occidentale*
Cashew apple	India	*Anacardium occidentale*
Cashew bark	Jamaica	*Anacardium occidentale*
Cashew nut tree	India	*Anacardium occidentale*
Cashew nut	Brazil	*Anacardium occidentale*
Cashew nut	India	*Anacardium occidentale*
Cashew nut	USA	*Anacardium occidentale*
Cashew tree	South Africa	*Anacardium occidentale*
Cashew	Guyana	*Anacardium occidentale*
Cashu	Peru	*Anacardium occidentale*
Castor bean plant	Guam	*Ricinus communis*
Castor bean	Saudi Arabia	*Ricinus communis*
Castor bean	USA	*Ricinus communis*
Castor oil bush	West Indies	*Ricinus communis*
Castor oil plant	Guyana	*Ricinus communis*
Castor oil plant	Nepal	*Ricinus communis*
Castor oil plant	USA	*Ricinus communis*
Castor	Algeria	*Ricinus communis*
Castor	Nepal	*Ricinus communis*
Cau	Indonesia	*Musa sapientum*
Caujil	Colombia	*Anacardium occidentale*
Cay thom	India	*Ananas comosus*
Ceba	France	*Allium cepa*
Cebo	France	*Allium cepa*
Cebolla morada	Mexico	*Allium cepa*
Cebolla	Guatemala	*Allium cepa*
Cebolla	Nicaragua	*Allium cepa*
Cebolla	Peru	*Allium cepa*
Cepa bulb	Kuwait	*Allium cepa*
Cepolla	Italy	*Allium cepa*
Cha-em-thet	Thailand	*Glycyrrhiza glabra*
Chamomile	Argentina	*Matricaria chamomilla*

Common name	Country	Latin binomial
Chamomile	England	*Matricaria chamomilla*
Chamomile	Estonia	*Matricaria chamomilla*
Chamomile	India	*Matricaria chamomilla*
Chamomile	Japan	*Matricaria chamomilla*
Chamomille	Mexico	*Matricaria chamomilla*
Chamomille	Nicaragua	*Matricaria chamomilla*
Chan thet	Thailand	*Myristica fragrans*
Chan	Thailand	*Myristica fragrans*
Chaste tree	Croatia	*Vitex agnus-castus*
Chaste tree	Europe	*Vitex agnus-castus*
Chaste tree	France	*Vitex agnus-castus*
Chaste tree	Germany	*Vitex agnus-castus*
Chaste tree	India	*Vitex agnus-castus*
Chaste tree	Iran	*Vitex agnus-castus*
Chek	Thailand	*Musa sapientum*
China tree	Indonesia	*Azadirachta indica*
Chinaberry	Indonesia	*Azadirachta indica*
Chinaberry	USA	*Azadirachta indica*
Chinese angelica	China	*Angelica sinensis*
Chinnipalleru	India	*Tribulus terrestris*
Chirupalleru	India	*Tribulus terrestris*
Chota gokharu	India	*Tribulus terrestris*
Chrysanthemum	Germany	*Matricaria chamomilla*
Chura	Colombia	*Anacardium occidentale*
Cipolla	Italy	*Allium cepa*
Cockerell	Dominica	*Ananas comosus*
Coga macon	East Africa	*Ricinus communis*
Comb flower	USA	*Echinacea angustifolia*
Common onion	Kuwait	*Allium cepa*
Cone flower	USA	*Echinacea angustifolia*
Corazancillo	Spain	*Hypericum perforatum*
Corazoncillo	Argentina	*Hypericum perforatum*
Cow's hoof	India	*Tribulus terrestris*
Croix de Malte	India	*Tribulus terrestris*
Cu hanh	Vietnam	*Allium cepa*
Cyclamen	Arabic countries	*Vitex agnus-castus*
Dang gui	China	*Angelica sinensis*
Danggui	China	*Angelica sinensis*
Darbejiya	Nigeria	*Azadirachta indica*
Demirdiken	Turkey	*Tribulus terrestris*
Dendhu	India	*Hypericum perforatum*
Derakhte barge boo	Iran	*Laurus nobilis*
Deshi gokhru	India	*Tribulus terrestris*
Devil's scorge	Europe	*Hypericum perforatum*
Devil's thorn	India	*Tribulus terrestris*

Common name	Country	Latin binomial
Dhatura	Nepal	*Ricinus communis*
Dilo-K	India	*Morinda citrifolia*
Dogo yaro	Nigeria	*Azadirachta indica*
Dogonyaro	Nigeria	*Azadirachta indica*
Domates	Turkey	*Lycopersicon esculentum*
Dong quai	China	*Angelica sinensis*
Dorg-chan	Thailand	*Myristica fragrans*
Dumadu	Nicaragua	*Lycopersicon esculentum*
East Indian lotus	Nepal	*Nelumbo nucifera*
Echinaceae	USA	*Echinacea angustifolia*
Eibisch	France	*Althaea officinales*
Eisenblut	Europe	*Hypericum perforatum*
Ekanty	India	*Tribulus terrestris*
El ban	Sudan	*Eucalyptus globulus*
English Chamomile	Japan	*Matricaria chamomilla*
Era	India	*Ricinus communis*
Erand	India	*Ricinus communis*
Eranda	India	*Ricinus communis*
Erande	India	*Ricinus communis*
Erandu	India	*Ricinus communis*
Erendi	India	*Ricinus communis*
Erra-tamara	India	*Nelumbo nucifera*
Erund	India	*Ricinus communis*
Erva molle	Italy	*Althaea officinales*
Eucalipto blanco	Canary Islands	*Eucalyptus globulus*
Eucalipto	Bolivia	*Eucalyptus globulus*
Eucalipto	Brazil	*Eucalyptus globulus*
Eucalipto	Canary Islands	*Eucalyptus globulus*
Eucalipto	Guatemala	*Eucalyptus globulus*
Eucalipto	Italy	*Eucalyptus globulus*
Eucalipto	Mexico	*Eucalyptus globulus*
Eucalipto	Peru	*Eucalyptus globulus*
Eucaliptus	Spain	*Eucalyptus globulus*
Eucalyptus	Tunisia	*Eucalyptus globulus*
Eucalyptus	Australia	*Eucalyptus globulus*
Eucalyptus	France	*Eucalyptus globulus*
Eucalyptus	Guyana	*Eucalyptus globulus*
Eucalyptus	Philippines	*Eucalyptus globulus*
Eucalyptus	West Indies	*Eucalyptus globulus*
Eun-haeng	Korea	*Ginkgo biloba*
Fampinonoana	Madagascar	*Ricinus communis*
Featherfew	England	*Tanacetum parthenium*
Featherfew	USA	*Tanacetum parthenium*
Febrifuge plant	USA	*Tanacetum parthenium*
Felfele berry	Iran	*Vitex agnus-castus*

Common name	Country	Latin binomial
Feverfew tansy	Madeira	*Tanacetum parthenium*
Feverfew	Canada	*Tanacetum parthenium*
Feverfew	Croatia	*Tanacetum parthenium*
Feverfew	England	*Tanacetum parthenium*
Feverfew	Israel	*Tanacetum parthenium*
Feverfew	USA	*Tanacetum parthenium*
Flor De Sao Joao	Madeira	*Hypericum perforatum*
Fuga daemonum	Europe	*Hypericum perforatum*
Gai ma duong	China	*Tribulus terrestris*
Gancao	China	*Glycyrrhiza glabra*
Gar	Jordan	*Laurus nobilis*
Gatha	Qatar	*Tribulus terrestris*
Gattilier	France	*Vitex agnus-castus*
Gekkeiju	Japan	*Laurus nobilis*
German Chamomile	USA	*Matricaria chamomilla*
German Chamomille	England	*Matricaria chamomilla*
Gigante	Mexico	*Eucalyptus globulus*
Ginkgo nut	Japan	*Ginkgo biloba*
Ginkgo tree	USA	*Ginkgo biloba*
Ginkgo	Iran	*Ginkgo biloba*
Ginkgo	Japan	*Ginkgo biloba*
Ginkgo	Korea	*Ginkgo biloba*
Ginkyo	Japan	*Ginkgo biloba*
Ginnan	Japan	*Ginkgo biloba*
Gin-nan	Japan	*Ginkgo biloba*
Glycyrrhiza radix	Japan	*Glycyrrhiza glabra*
Glycyrrhiza	USA	*Glycyrrhiza glabra*
Glycyrrhizae radix	China	*Glycyrrhiza glabra*
Gojeh farangee	Iran	*Lycopersicon esculentum*
Gokhatri	India	*Tribulus terrestris*
Gokhru	India	*Tribulus terrestris*
Gokhrudesi	India	*Tribulus terrestris*
Gokhuru	Pakistan	*Tribulus terrestris*
Gokshura	India	*Tribulus terrestris*
Gori	India	*Azadirachta indica*
Goz buwwa	Egypt	*Myristica fragrans*
Goz it-tib	Egypt	*Myristica fragrans*
Gringging	Indonesia	*Azadirachta indica*
Guimauve	France	*Althaea officinales*
Guimauve	Tunisia	*Althaea officinales*
Gum tree	USA	*Eucalyptus globulus*
Gum tree	West Indies	*Eucalyptus globulus*
Gusetsu	China	*Nelumbo nucifera*
Guzt s-serq	Morocco	*Myristica fragrans*
Guzt t-tib	Morocco	*Myristica fragrans*

Common name	Country	Latin binomial
Habbat hlawa	Morocco	*Pimpinella anisum*
Hab-el-ghar	India	*Laurus nobilis*
Habet L-gar	Morocco	*Laurus nobilis*
Hag apple	Nicaragua	*Morinda citrifolia*
Hartheu	Europe	*Hypericum perforatum*
Harwaa	Tunisia	*Ricinus communis*
Hayit	Turkey	*Vitex agnus-castus*
Hedgehog	USA	*Echinacea angustifolia*
Hemp tree	India	*Vitex agnus-castus*
Heofariqon	Arabic Countries	*Hypericum perforatum*
Herba de la mera	France	*Matricaria chamomilla*
Herba de Millepertuis	France	*Hypericum perforatum*
Herba de Saint Jean	France	*Hypericum perforatum*
Herrgottsblut	Germany	*Hypericum perforatum*
Hexenkraut	Europe	*Hypericum perforatum*
Hierba De San Juan	Spain	*Hypericum perforatum*
Hierba Santa Maria	Canary Islands	*Tanacetum parthenium*
Higuereta	Cuba	*Ricinus communis*
Higuereta	Puerto Rico	*Ricinus communis*
Higuerilla blanca	Mexico	*Ricinus communis*
Higuerilla	Colombia	*Ricinus communis*
Higuerilla	Mexico	*Ricinus communis*
Higuerilla	Peru	*Ricinus communis*
Higuerillo blanco	Colombia	*Ricinus communis*
Higuerillo rojo	Colombia	*Ricinus communis*
Higuerillo	Guatemala	*Ricinus communis*
Higuero	Nicaragua	*Ricinus communis*
Hindu lotus	China	*Nelumbo nucifera*
Hipericao	Madeira	*Hypericum perforatum*
Hiperico	Argentina	*Hypericum perforatum*
Hipericon	Argentina	*Hypericum perforatum*
Hipericon	Spain	*Hypericum perforatum*
Hobbiza	Tunisia	*Althaea officinales*
Hom khaao	Thailand	*Allium cepa*
Hom yai	Thailand	*Allium cepa*
Hua phak bua	Vietnam	*Allium cepa*
Hungarian Chamomile	USA	*Matricaria chamomilla*
Hu-tsung	China	*Allium cepa*
Iaiaua	West Indies	*Ananas comosus*
I-bsel	Tunisia	*Allium cepa*
Icahpe Hu	USA	*Echinacea angustifolia*
Ice leaf	Nicaragua	*Morinda citrifolia*
Icho	Japan	*Ginkgo biloba*
Idiaua	Dominica	*Ananas comosus*
Igi-oba	Nigeria	*Azadirachta indica*

Common name	Country	Latin binomial
Iguwu	Gabon	*Ananas comosus*
Ikshugandha	India	*Tribulus terrestris*
Imba	India	*Azadirachta indica*
Indian bay	USA	*Laurus nobilis*
Indian lilac	India	*Azadirachta indica*
Indian lotus	Japan	*Nelumbo nucifera*
Indian mulberry	Hawaii	*Morinda citrifolia*
Indian mulberry	Indonesia	*Morinda citrifolia*
Indian mulberry	Thailand	*Morinda citrifolia*
Indian neem tree	Kenya	*Azadirachta indica*
Inshtogahte-Hi	USA	*Echinacea angustifolia*
Intaran	Indonesia	*Azadirachta indica*
Inyan	Nicaragua	*Allium cepa*
Iperico	Italy	*Hypericum perforatum*
Isa-bevu	India	*Azadirachta indica*
Isu opego	Nigeria	*Musa sapientum*
Ityo	Japan	*Ginkgo biloba*
Ix K' O' Och	Guatemala	*Ricinus communis*
Jaiphal	Fiji	*Myristica fragrans*
Jaiphal	Nepal	*Myristica fragrans*
Jakyakgamcho-tang	South Korea	*Glycyrrhiza glabra*
Jar	Saudi Arabia	*Ricinus communis*
Jashtimadhu	India	*Glycyrrhiza glabra*
Jatiphal	India	*Myristica fragrans*
Jeshtamadh	India	*Glycyrrhiza glabra*
Jethimadha	India	*Glycyrrhiza glabra*
Jili	Taiwan	*Tribulus terrestris*
Jilisi	China	*Tribulus terrestris*
Jitomate	Mexico	*Lycopersicon esculentum*
Johaniskraut	Germany	*Hypericum perforatum*
Johannesort	Sweden	*Hypericum perforatum*
Johanniskraut	Europe	*Hypericum perforatum*
Jurema	Brazil	*Vitex agnus-castus*
Kadalam	India	*Musa sapientum*
Kadalamu	India	*Musa sapientum*
Kadali	India	*Musa sapientum*
Kadu	Senegal	*Anacardium occidentale*
Kaju badam	India	*Anacardium occidentale*
Kaju	India	*Anacardium occidentale*
Kaju	Nigeria	*Anacardium occidentale*
Kajutaka	India	*Anacardium occidentale*
Kala	India	*Musa sapientum*
Kalatus	Tunisia	*Eucalyptus globulus*
Kalung	India	*Nelumbo nucifera*

Common name	Country	Latin binomial
Kamal	India	*Nelumbo nucifera*
Kamal	Nepal	*Nelumbo nucifera*
Kamala	India	*Nelumbo nucifera*
Kamille	France	*Matricaria chamomilla*
Kamitsure	Japan	*Matricaria chamomilla*
Kamiture	Japan	*Matricaria chamomilla*
Kandalai	Pakistan	*Tribulus terrestris*
Kanpo	Japan	*Glycyrrhiza glabra*
Kansas niggerhead	USA	*Echinacea angustifolia*
Kansas snakeroot	USA	*Echinacea angustifolia*
Kanti	India	*Tribulus terrestris*
Kanzo	Japan	*Glycyrrhiza glabra*
Kara toki	Hong Kong	*Angelica sinensis*
Kasantaya	Nicaragua	*Anacardium occidentale*
Kasau	Nicaragua	*Anacardium occidentale*
Kashumavu	India	*Anacardium occidentale*
Kasjoe	Surinam	*Anacardium occidentale*
Kastalan qajne	Mexico	*Ricinus communis*
Kateh	Thailand	*Ananas comosus*
Kathal saphri	India	*Ananas comosus*
Kattatogaru	India	*Morinda citrifolia*
Kayo	Japan	*Nelumbo nucifera*
Kef-meriem	France	*Vitex agnus-castus*
Kela	India	*Musa sapientum*
Keli	India	*Musa sapientum*
Kerosin	Nicaragua	*Myristica fragrans*
Kerwa	Morocco	*Ricinus communis*
Kerwa	Morocco	*Vitex agnus-castus*
Keuschlamm	Europe	*Vitex agnus-castus*
Khairi	Arabic countires	*Althaea officinales*
Kharwa	Egypt	*Ricinus communis*
Kharwa	Oman	*Ricinus communis*
Kharwaa	Quatar	*Ricinus communis*
Khatmi	India	*Althaea officinales*
Khatmi-ka-phool	India	*Althaea officinales*
Kherwa	Jordan	*Ricinus communis*
Kherwa	Saudi Arabia	*Ricinus communis*
Khiruwi	Sudan	*Ricinus communis*
Khirwa	Saudi Arabia	*Ricinus communis*
Khokkrasan	Thailand	*Tribulus terrestris*
Khtim	Vietnam	*Allium cepa*
Kiswahili	Tanzania	*Azadirachta indica*
Kitunguu	Tanzania	*Allium cepa*
Kluai tai	Thailand	*Musa sapientum*

Common name	Country	Latin binomial
Kluai	Thailand	*Musa sapientum*
Kohomba	Sri Lanka	*Azadirachta indica*
Kokulla	India	*Tribulus terrestris*
Koli	Hawaii	*Ricinus communis*
Krapata	Suriname	*Ricinus communis*
Krunda	India	*Tribulus terrestris*
Ksapitahako	USA	*Echinacea angustifolia*
Kubisa	Senegal	*Anacardium occidentale*
Kuppi	India	*Pimpinella anisum*
Kura	Thailand	*Morinda citrifolia*
Kuraua	Dominica	*Ananas comosus*
Kusu	Guinea	*Anacardium occidentale*
Laek	Thailand	*Musa sapientum*
Lagarto pina	Peru	*Ananas comosus*
Lahhango-khru	India	*Tribulus terrestris*
Langbodo	Nigeria	*Musa sapientum*
Langdu danggui	China	*Angelica sinensis*
Laurel comun	Argentina	*Laurus nobilis*
Laurel noble	Argentina	*Laurus nobilis*
Laurel real	Peru	*Laurus nobilis*
Laurel tree	Iran	*Laurus nobilis*
Lauriello	Italy	*Laurus nobilis*
Laurier D'apollon	France	*Laurus nobilis*
Laurier sauce	Tunisia	*Laurus nobilis*
Lauro	Italy	*Laurus nobilis*
Legezabwende	Tanzania	*Ricinus communis*
Lepo	Tanzania	*Ricinus communis*
Lepo	Tonga	*Ricinus communis*
Lepohina	Tanzania	*Ricinus communis*
Lepohina	Tonga	*Ricinus communis*
Lepokula	Tanzania	*Ricinus communis*
Lepokula	Tonga	*Ricinus communis*
Lian	China	*Nelumbo nucifera*
Libono	East Africa	*Ricinus communis*
Licorice root	USA	*Glycyrrhiza glabra*
Licorice	Israel	*Glycyrrhiza glabra*
Licorice	New Zealand	*Glycyrrhiza glabra*
Licorice	Spain	*Glycyrrhiza glabra*
Licorice	USA	*Glycyrrhiza glabra*
Liebeskraut	Europe	*Hypericum perforatum*
Lilas de perse	Rodrigues Islands	*Azadirachta indica*
Limb	India	*Azadirachta indica*
Limbado	India	*Azadirachta indica*
Liquorice	India	*Glycyrrhiza glabra*
L'oignon	West Indies	*Allium cepa*

Common name	Country	Latin binomial
Lorbeerfrucht	Italy	*Laurus nobilis*
Lotak	India	*Tribulus terrestris*
Lotus	Cambodia	*Nelumbo nucifera*
Lotus	India	*Nelumbo nucifera*
Lotus	Japan	*Nelumbo nucifera*
Lotus	Nepal	*Nelumbo nucifera*
Loyon	West Indies	*Allium cepa*
Luk-chat-tet	Thailand	*Myristica fragrans*
Lupono	Tanzania	*Ricinus communis*
Luzab	Yemen	*Tanacetum parthenium*
Ma khue thet	Thailand	*Lycopersicon esculentum*
Mace	Japan	*Myristica fragrans*
Mace	USA	*Myristica fragrans*
Maddi	India	*Morinda citrifolia*
Madhuyasthi rasayama	India	*Glycyrrhiza glabra*
Madras onion	West Indies	*Allium cepa*
Mahanim	India	*Azadirachta indica*
Mahanimba	India	*Azadirachta indica*
Mahnimu	India	*Azadirachta indica*
Mahuang	China	*Ephedra sinica*
Ma-huang	China	*Ephedra sinica*
Maiden hair tree	China	*Ginkgo biloba*
Maiden hair tree	Germany	*Ginkgo biloba*
Maiden hair tree	India	*Ginkgo biloba*
Maiden hair tree	Iran	*Ginkgo biloba*
Maiden hair tree	Japan	*Ginkgo biloba*
Maiden hair tree	Korea	*Ginkgo biloba*
Maiden hair tree	USA	*Ginkgo biloba*
Ma-li-ong	Thailand	*Musa sapientum*
Malva blanca	France	*Althaea officinales*
Malvavisco	Bolivia	*Althaea officinales*
Malvavisco	Peru	*Althaea officinales*
Mamona	Brazil	*Ricinus communis*
Mannanatti	India	*Morinda citrifolia*
Manzanilla chiquita	Colombia	*Matricaria chamomilla*
Manzanilla comun	Colombia	*Matricaria chamomilla*
Manzanilla dulce	Colombia	*Matricaria chamomilla*
Manzanilla romana	Colombia	*Matricaria chamomilla*
Manzanilla	Argentina	*Matricaria chamomilla*
Manzanilla	Bolivia	*Matricaria chamomilla*
Manzanilla	Guatemala	*Matricaria chamomilla*
Manzanilla	Honduras	*Matricaria chamomilla*
Manzanilla	Mexico	*Matricaria chamomilla*
Manzanilla	Nicaragua	*Matricaria chamomilla*
Manzanilla	Peru	*Matricaria chamomilla*

Common name	Country	Latin binomial
Manzilla	Guatemala	*Matricaria chamomilla*
Mao	Japan	*Ephedra sinica*
Maoh	Japan	*Ephedra sinica*
Mao-kon	China	*Ephedra sinica*
Maou	China	*Ephedra sinica*
Maranon	Colombia	*Anacardium occidentale*
Maranon	Guatemala	*Anacardium occidentale*
Maranon	Nicaragua	*Anacardium occidentale*
Maranon	Panama	*Anacardium occidentale*
Maranon	Peru	*Anacardium occidentale*
Margosa tree	India	*Azadirachta indica*
Margosa tree	Nepal	*Azadirachta indica*
Margosa	India	*Azadirachta indica*
Marmolone	Italy	*Althaea officinales*
Marsh mallow	Bolivia	*Althaea officinales*
Marsh mallow	Poland	*Althaea officinales*
Marsh mallow	USA	*Althaea officinales*
Masketi	Haiti	*Ricinus communis*
Matricaire	France	*Matricaria chamomilla*
Matricaire	Tunisia	*Matricaria chamomilla*
Matricaria comun	Argentina	*Tanacetum parthenium*
Matricaris	France	*Matricaria chamomilla*
Mbiba	Tanzania	*Anacardium occidentale*
Mbibo	Tanzania	*Anacardium occidentale*
Mbono	East Africa	*Ricinus communis*
Mbonu	East Africa	*Ricinus communis*
Meethagokhru	India	*Tribulus terrestris*
Memoscada	Nicaragua	*Myristica fragrans*
Mengkudu	Brunei	*Morinda citrifolia*
Merey	Colombia	*Anacardium occidentale*
Mika-Hi	USA	*Echinacea angustifolia*
Mimba	India	*Azadirachta indica*
Minamaram	India	*Morinda citrifolia*
Mindi	Indonesia	*Azadirachta indica*
Min-gui	China	*Angelica sinensis*
Miro Tahiti	Easter Island	*Azadirachta indica*
Misgadu	Nicaragua	*Myristica fragrans*
Miskad	Guadeloupe	*Myristica fragrans*
Miskad	Trinidad	*Myristica fragrans*
Miskad	West Indies	*Myristica fragrans*
Mitha-jira	India	*Pimpinella anisum*
Mithgokhru	India	*Tribulus terrestris*
Mkorosho	Tanzania	*Anacardium occidentale*
Monchpfeffer	Europe	*Vitex agnus-castus*
Monk's pepper tree	Iran	*Vitex agnus-castus*

Common name	Country	Latin binomial
Monk's pepper tree	India	*Vitex agnus-castus*
Morethi	India	*Glycyrrhiza glabra*
Morinda	Fiji	*Morinda citrifolia*
Mouz	Iran	*Musa sapientum*
Muhuri	India	*Pimpinella anisum*
Mulathi	India	*Glycyrrhiza glabra*
Mulethi	India	*Glycyrrhiza glabra*
Muleti	India	*Glycyrrhiza glabra*
Mulhati	India	*Glycyrrhiza glabra*
Mulhatti	India	*Glycyrrhiza glabra*
Munthamaamidi	India	*Anacardium occidentale*
Mupfure	Venda	*Ricinus communis*
Muscade	Guadeloupe	*Myristica fragrans*
Muscade	Trinidad	*Myristica fragrans*
Muscade	West Indies	*Myristica fragrans*
Muscade	Yugoslavia	*Myristica fragrans*
Muskat	Yugoslavia	*Myristica fragrans*
Muskatnusz	Germany	*Myristica fragrans*
Mutterkraut	Europe	*Tanacetum parthenium*
Mwagum wagum	Papua	*Morinda citrifolia*
Mwarobaini	Tanzania	*Azadirachta indica*
Mwriki	East Africa	*Ricinus communis*
Nahhanagokhru	India	*Tribulus terrestris*
Nanas	Indonesia	*Ananas comosus*
Nanas	Malaysia	*Ananas comosus*
Neeb	Tanzania	*Azadirachta indica*
Neem	USA	*Azadirachta indica*
Neem	Antigua	*Azadirachta indica*
Neem	Fiji	*Azadirachta indica*
Neem	Gambia	*Azadirachta indica*
Neem	Guyana	*Azadirachta indica*
Neem	India	*Azadirachta indica*
Neem	Kenya	*Azadirachta indica*
Neem	Nepal	*Azadirachta indica*
Neem	Nigeria	*Azadirachta indica*
Neem	Philippines	*Azadirachta indica*
Neem	Sudan	*Azadirachta indica*
Neem	Trinidad	*Azadirachta indica*
Neem	West Indies	*Azadirachta indica*
Nelum	Sri Lanka	*Nelumbo nucifera*
Nenas	Malaysia	*Ananas comosus*
Nerenchi	Sri Lanka	*Tribulus terrestris*
Nerinjeekai	India	*Tribulus terrestris*
Nerunji	India	*Tribulus terrestris*
Nhau nui	Vietnam	*Morinda citrifolia*

Common name	Country	Latin binomial
Nhau	Vietnam	*Morinda citrifolia*
Nho	Vietnam	*Morinda citrifolia*
Nhor prey	Vietnam	*Morinda citrifolia*
Nhor thom	Vietnam	*Morinda citrifolia*
Nigger head	USA	*Echinacea angustifolia*
Nim tree	India	*Azadirachta indica*
Nim	Fiji	*Azadirachta indica*
Nim	India	*Azadirachta indica*
Nim	Nepal	*Azadirachta indica*
Nimba	India	*Azadirachta indica*
Nimbatikta	India	*Azadirachta indica*
Nivaquine	Senegal	*Azadirachta indica*
Noix d'acajou	West Indies	*Anacardium occidentale*
Noix de cajou	Senegal	*Anacardium occidentale*
Noko	Papua-New Guinea	*Morinda citrifolia*
Noni	Guyana	*Morinda citrifolia*
Noni	Hawaii	*Morinda citrifolia*
Nono	Cook Islands	*Morinda citrifolia*
Nono	Rarotonga	*Morinda citrifolia*
Nonu	Tonga	*Morinda citrifolia*
Noronda	India	*Ricinus communis*
Ntoo qaib lab	USA-MN	*Ricinus communis*
Nuez moscada	Mexico	*Myristica fragrans*
Nuez moscada	Nicaragua	*Myristica fragrans*
Nuez moscada	Peru	*Myristica fragrans*
Nuholani	Hawaii	*Eucalyptus globulus*
Nuna	India	*Morinda citrifolia*
Nutmeg mace	Trinidad	*Myristica fragrans*
Nutmeg	Brazil	*Myristica fragrans*
Nutmeg	East Indies	*Myristica fragrans*
Nutmeg	Europe	*Myristica fragrans*
Nutmeg	Grenada	*Myristica fragrans*
Nutmeg	Guyana	*Myristica fragrans*
Nutmeg	Jamaica	*Myristica fragrans*
Nutmeg	Japan	*Myristica fragrans*
Nutmeg	Nepal	*Myristica fragrans*
Nutmeg	Puerto Rico	*Myristica fragrans*
Nutmeg	USA	*Myristica fragrans*
Nutmeg	West Indies	*Myristica fragrans*
Nux moschata	USA	*Myristica fragrans*
Nyanya	Tanzania	*Lycopersicon esculentum*
Odagwa	Kenya	*Ricinus communis*
Ogede wewe	Nigeria	*Musa sapientum*
Ogede	Iran	*Musa sapientum*
Oignon	Rodrigues Islands	*Allium cepa*

Common name	Country	Latin binomial
Oignon	France	*Allium cepa*
Oignon	Tunisia	*Allium cepa*
Oignon	Vietnam	*Allium cepa*
Oko	Papau-New Guinea	*Morinda citrifolia*
On glakcapi	USA	*Echinacea angustifolia*
Onion	Europe	*Allium cepa*
Onion	Netherlands	*Allium cepa*
Onion	Brazil	*Allium cepa*
Onion	Egypt	*Allium cepa*
Onion	Greece	*Allium cepa*
Onion	Guyana	*Allium cepa*
Onion	India	*Allium cepa*
Onion	Iran	*Allium cepa*
Onion	Japan	*Allium cepa*
Onion	Kuwait	*Allium cepa*
Onion	Mexico	*Allium cepa*
Onion	Nepal	*Allium cepa*
Onion	Nicaragua	*Allium cepa*
Onion	Tanzania	*Allium cepa*
Onion	USA	*Allium cepa*
Padma	India	*Nelumbo nucifera*
Pain killer	Guyana	*Morinda citrifolia*
Pain killer	Virgin Islands	*Morinda citrifolia*
Painap	Fiji	*Ananas comosus*
Painappuru	Fiji	*Ananas comosus*
Pakhra	Pakistan	*Tribulus terrestris*
Pale-purple coneflower	USA	*Echinacea angustifolia*
Palkcha	Mexico	*Lycopersicon esculentum*
Palleru	India	*Tribulus terrestris*
Pallerukayalu	India	*Tribulus terrestris*
Palma christi	Mauritius	*Ricinus communis*
Palma christi	USA	*Ricinus communis*
Palma christi	West Indies	*Ricinus communis*
Palma de Cristo	Brazil	*Ricinus communis*
Pamposh	India	*Nelumbo nucifera*
Panj angosht	Iran	*Vitex agnus-castus*
Pankaj	India	*Nelumbo nucifera*
Patje	Indonesia	*Morinda citrifolia*
Pedda palgeru	India	*Tribulus terrestris*
Pega-dousa	France	*Glycyrrhiza glabra*
Pelatro	Italy	*Hypericum perforatum*
Pelicao	Madeira	*Hypericum perforatum*
Pemi	Bougainville	*Morinda citrifolia*
Perforata	Italy	*Hypericum perforatum*
Persian licorice	Iran	*Glycyrrhiza glabra*

Common name	Country	Latin binomial
Petit anise	North Africa	*Pimpinella anisum*
Piaz	Iran	*Allium cepa*
Pin heads	Europe	*Matricaria chamomilla*
Pina comun	Puerto Rico	*Ananas comosus*
Pina	Guatemala	*Ananas comosus*
Pina	Peru	*Ananas comosus*
Pina	Philippines	*Ananas comosus*
Pina	Puerto Rico	*Ananas comosus*
Pindra	India	*Morinda citrifolia*
Pine	Guyana	*Ananas comosus*
Pineapple plant	India	*Ananas comosus*
Pineapple	Dominica	*Ananas comosus*
Pineapple	Fiji	*Ananas comosus*
Pineapple	Guyana	*Ananas comosus*
Pineapple	India	*Ananas comosus*
Pineapple	Indonesia	*Ananas comosus*
Pineapple	Japan	*Ananas comosus*
Pineapple	Malaysia	*Ananas comosus*
Pineapple	Tahiti	*Ananas comosus*
Pineapple	Taiwan	*Ananas comosus*
Pineapple	Thailand	*Ananas comosus*
Pineapple	Trinidad	*Ananas comosus*
Pineapple	USA	*Ananas comosus*
Pineapple	West Indies	*Ananas comosus*
Pinillo de Oro	Spain	*Hypericum perforatum*
Pisang	Indonesia	*Musa sapientum*
Piyaj	Fiji	*Allium cepa*
Piyaj	India	*Allium cepa*
Piyaz	Fiji	*Allium cepa*
Plaepiwa	Hawaii	*Eucalyptus globulus*
Platana	Mexico	*Musa sapientum*
Plumula nelumbinis	China	*Nelumbo nucifera*
Podum	India	*Nelumbo nucifera*
Pom kajou	Haiti	*Anacardium occidentale*
Pom	West Indies	*Anacardium occidentale*
Pomaskwiti	West Indies	*Ricinus communis*
Pomme d'acajou	Guinea	*Anacardium occidentale*
Pomme D'amour	Rodrigues Islands	*Lycopersicon esculentum*
Pomme d'cajou	West Indies	*Anacardium occidentale*
Pommier cajou	Senegal	*Anacardium occidentale*
Pomodoro	Italy	*Lycopersicon esculentum*
Pulukamu	Tonga	*Eucalyptus globulus*
Pummarola	Italy	*Lycopersicon esculentum*
Puncture vine	USA	*Tribulus terrestris*
Pundarika	India	*Nelumbo nucifera*

Common name	Country	Latin binomial
Purple cone flower	USA	*Echinacea angustifolia*
Pyaz	India	*Allium cepa*
Pyaz	Nepal	*Allium cepa*
Qian Ceng lou	China	*Hypericum perforatum*
Querosin	Nicaragua	*Myristica fragrans*
Ranukabija ma	India	*Vitex agnus-castus*
Rasha	India	*Tribulus terrestris*
Razianaj	Arabic countries	*Pimpinella anisum*
Recalisse	France	*Glycyrrhiza glabra*
Red chicken tree	USA-MN	*Ricinus communis*
Red eagle foot	USA-MN	*Ricinus communis*
Red globe onion	USA	*Allium cepa*
Redh	Fiji	*Ricinus communis*
Redhi	Fiji	*Ricinus communis*
Reglisse	France	*Glycyrrhiza glabra*
Renbo	China	*Nelumbo nucifera*
Rend	Tunisia	*Laurus nobilis*
Rendi	India	*Ricinus communis*
Renniku	Japan	*Nelumbo nucifera*
Ricin	Tunisia	*Ricinus communis*
Ricino	Brazil	*Ricinus communis*
Ricino	Colombia	*Ricinus communis*
Ricino	Guinea-Bissau	*Ricinus communis*
Riro	Bougainville	*Morinda citrifolia*
Roudoukou	China	*Myristica fragrans*
Sadao India	Thailand	*Azadirachta indica*
Sadao tree	Thailand	*Azadirachta indica*
Sadao	Thailand	*Azadirachta indica*
Sa-Dao	Thailand	*Azadirachta indica*
Sadikka	India	*Myristica fragrans*
Saint John's wort	Greece	*Hypericum perforatum*
Sakui	Thailand	*Musa sapientum*
Salukid ba	India	*Nelumbo nucifera*
Sampson root	USA	*Echinacea angustifolia*
Sanjuanera	Spain	*Hypericum perforatum*
Sanna neggilu	India	*Tribulus terrestris*
Santa Maria	Argentina	*Tanacetum parthenium*
Santa Maria	Mexico	*Tanacetum parthenium*
Sap parot	Thailand	*Ananas comosus*
Sapariou hahts	USA	*Echinacea angustifolia*
Sarala	India	*Tribulus terrestris*
Saunf Star anise	India	*Pimpinella anisum*
Saunf	India	*Pimpinella anisum*
Sauzatillo	France	*Vitex agnus-castus*
Sawonf	India	*Pimpinella anisum*

Common name	Country	Latin binomial
Scurvy root	USA	*Echinacea angustifolia*
Sebuya	Nicaragua	*Allium cepa*
Senthamara	India	*Nelumbo nucifera*
Shallot	China	*Allium cepa*
Sharatte	India	*Tribulus terrestris*
Shitsurishi	China	*Tribulus terrestris*
Shombu	India	*Pimpinella anisum*
Sibuyas	India	*Allium cepa*
Sint-Janskruid	Netherlands	*Hypericum perforatum*
Si-pei	China	*Glycyrrhiza glabra*
Small caltrop	Kuwait	*Tribulus terrestris*
Sogan	Turkey	*Allium cepa*
Soh-lapudong	India	*Nelumbo nucifera*
Soma	India	*Ephedra sinica*
Somo	Guinea	*Anacardium occidentale*
Somp	India	*Pimpinella anisum*
Sop	India	*Pimpinella anisum*
Sop	Nepal	*Pimpinella anisum*
Sopu	India	*Pimpinella anisum*
Spanish licorice	Spain	*Glycyrrhiza glabra*
Spanish onion	USA	*Allium cepa*
S-Sibisa	Morocco	*Myristica fragrans*
St John's worth	Canada	*Hypericum perforatum*
St John's worth	Germany	*Hypericum perforatum*
St. John's wort	USA	*Hypericum perforatum*
St. John's worth	Estonia	*Hypericum perforatum*
Star anise	USA	*Pimpinella anisum*
Surangi	India	*Morinda citrifolia*
Suriyakamal	India	*Nelumbo nucifera*
Sussholzwurzel	Spain	*Glycyrrhiza glabra*
Suzmool	India	*Althaea officinales*
Sweet bay	Iran	*Laurus nobilis*
Sweet Feverfew	England	*Matricaria chamomilla*
Sweet weed	USA	*Althaea officinales*
Sweet wood	USA	*Glycyrrhiza glabra*
Tagase	India	*Morinda citrifolia*
Takkali	India	*Lycopersicon esculentum*
Tamatar	Fiji	*Lycopersicon esculentum*
Tamatar	India	*Lycopersicon esculentum*
Tamatem	Tunisia	*Lycopersicon esculentum*
Tamatum	Oman	*Lycopersicon esculentum*
Tanacet	Canada	*Tanacetum parthenium*
Tang Kuei	China	*Angelica sinensis*
Tangkuei	China	*Angelica sinensis*
Tang-kwei	China	*Angelica sinensis*

Common name	Country	Latin binomial
Tat le	China	*Tribulus terrestris*
Tavare-gadde	India	*Nelumbo nucifera*
Te non	Bougainville	*Morinda citrifolia*
Tel-enderu	India	*Ricinus communis*
Tenturotou	Turkey	*Hypericum perforatum*
Teufelsflucht	Europe	*Hypericum perforatum*
Thamara	India	*Nelumbo nucifera*
Tobsha	Saudi Arabia	*Ricinus communis*
Tochem-I-bed-anjir	Afghanistan	*Ricinus communis*
Togaru	India	*Morinda citrifolia*
Tomat	Haiti	*Lycopersicon esculentum*
Tomate	France	*Lycopersicon esculentum*
Tomate	Guatemala	*Lycopersicon esculentum*
Tomate	Nicaragua	*Lycopersicon esculentum*
Tomate	Peru	*Lycopersicon esculentum*
Tomate	Puerto Rico	*Lycopersicon esculentum*
Tomatera	Spain	*Lycopersicon esculentum*
Tomatis	Nicaragua	*Lycopersicon esculentum*
Tomato	Greece	*Lycopersicon esculentum*
Tomato	Canada	*Lycopersicon esculentum*
Tomato	Czechoslovakia	*Lycopersicon esculentum*
Tomato	England	*Lycopersicon esculentum*
Tomato	Guyana	*Lycopersicon esculentum*
Tomato	India	*Lycopersicon esculentum*
Tomato	Iran	*Lycopersicon esculentum*
Tomato	Japan	*Lycopersicon esculentum*
Tomato	Tanzania	*Lycopersicon esculentum*
Tomato	Thailand	*Lycopersicon esculentum*
Tomato	USA	*Lycopersicon esculentum*
Tomato	Wales	*Lycopersicon esculentum*
Tomato	West Indies	*Lycopersicon esculentum*
Toto ni vavalagi	Afghanistan	*Ricinus communis*
Toutsaine	France	*Hypericum perforatum*
Tree of chastity	Iran	*Vitex agnus-castus*
Tsi li	China	*Tribulus terrestris*
Ttchakkma	Ethiopia	*Ricinus communis*
Txiv taw dlaav laab	USA-MN	*Ricinus communis*
Udukaju	Thailand	*Ricinus communis*
Unapalan	Nicaragua	*Ricinus communis*
Upal ba	India	*Nelumbo nucifera*
Ura	Rotuma	*Morinda citrifolia*
Uri	Nicaragua	*Anacardium occidentale*
Utouto	Nicaragua	*Ricinus communis*
Vala	India	*Musa sapientum*
Vazhaippazhan	India	*Musa sapientum*

Common name	Country	Latin binomial
Vel vangi	India	*Lycopersicon esculentum*
Vembu	India	*Azadirachta indica*
Vengayam	India	*Allium cepa*
Vepa	India	*Azadirachta indica*
Veppam	India	*Azadirachta indica*
Vilayithi baingan	India	*Lycopersicon esculentum*
Vilayithi vengan	India	*Lycopersicon esculentum*
Vudi dina	Fiji	*Musa sapientum*
Vudi	Fiji	*Musa sapientum*
Walmee	India	*Glycyrrhiza glabra*
Wasasashi	Japan	*Myristica fragrans*
Water lily	Guyana	*Nelumbo nucifera*
Welmii	India	*Glycyrrhiza glabra*
Wete pela celik	Argentina	*Ricinus communis*
White cedar	Indonesia	*Azadirachta indica*
White globe onion	USA	*Allium cepa*
Wild Chamomile	Germany	*Matricaria chamomilla*
Witcher's herb	Europe	*Hypericum perforatum*
Wymote	USA	*Althaea officinales*
Xi-bei	China	*Glycyrrhiza glabra*
Ya-khai	Thailand	*Musa sapientum*
Yalage porto	Guinea	*Anacardium occidentale*
Yashti	India	*Glycyrrhiza glabra*
Yashtimadhu	India	*Glycyrrhiza glabra*
Yeiawa harachan	Nicaragua	*Morinda citrifolia*
Yeiawa	Nicaragua	*Ananas comosus*
Yellow onion	USA	*Allium cepa*
Yeon-kot	Japan	*Nelumbo nucifera*
Yo	Thailand	*Morinda citrifolia*
Yukari	Tunisia	*Eucalyptus globulus*
Zama	India	*Tribulus terrestris*
Zanana	West Indies	*Ananas comosus*
Zanzalakhat	Saudi Arabia	*Azadirachta indica*
Zhanco	Iran	*Ginkgo biloba*
Zwieroboij	USSR	*Hypericum perforatum*

Glossary

Abortifacient An agent which causes the premature expulsion from the uterus of the products of conception – of the embryo, or of a nonviable fetus.

Acid phosphatase An enzyme that catalyzes the cleavage of orthophosphate under acid conditions.

Acinetobacter calcoaceticus A gram-negative, paired coccibacilli, aerobic, catalase-positive and oxidase-negative bacteria that is widely distributed in nature and is part of the normal mammalian flora, but can cause severe primary infections in compromised hosts.

Aconitine A poisonous drug from the dried tuberous root of *Aconitum napellus*. It was once given internally as a febrifuge and gastric anesthetic.

Adenosine deaminase An enzyme that catalyzes the deamination of adenosine to form inosine, a reaction of purine metabolism.

Adrenolytic An agent that inhibits the action of adrenergic nerves; inhibiting the response to epinephrine.

Aflatoxin A toxic factor produced by *Aspergillus flavus* and *A. parasiticus*, molds contaminating groundnut seedlings. In experimental animals, aflatoxin caused liver necrosis, bile duct proliferation, and cirrhosis, and on prolonged administration, leads to hepatocellular carcinoma and cholangiocarcinoma.

Agrobacterium tumefaciens A species of bacteria of the family Rhizobiaceae. It is a small, gram-negative, aerobic, flagellated rod that is found in the soil or in the roots or stems of plants. Most species produce hypertrophy (galls) in plant stems.

Alkaline phosphatase An enzyme that catalyzes the cleavage of orthophosphate under acid conditions.

Allergen An antigenic substance capable of producing immediate-type hypersensitivity (allergy).

Allergenic Acting as an allergen; inducing allergy.

Allergy A state of hypersensitivity induced by exposure to a particular antigen (allergen) resulting in harmful immunologic reactions on subsequent exposures.

Alpha amylase An enzyme secreted by the salivary glands and pancreas of mammals. It catalyzes the hydrolysis of internal alpha-1,4-glucosidic linkages in polysaccharides that contain three or more glucose residues.

Amenorrhea Absence or abnormal stoppage of menstruation.

Analgesic An agent that alleviates pain without causing loss of consciousness.

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Anclastogenic Preventing disruption or breakage, as of chromosomes.
Antiallergenic Preventing the induction of allergy.
Antiamnesic Preventing a lack or loss of memory.
Antianaphylactic Preventing the manifestation of immediate hypersensitivity in which exposure of a sensitized individual to a specific antigen results in urticaria, pruritis and angioedema, followed by vascular collapse and shock.
Antianginal Preventing or alleviating angina. An agent that prevents or alleviates spasmodic, choking, or suffocative pain of the thorax that often radiates to the arms, particularly the left, sometimes accompanied by a feeling of suffocation. The pain is most often due to ischemia or the myocardium and precipitated by effort or excitement.
Antiascariasis Destructive to intestinal parasites of the genus *Ascaris*, such as roundworm.
Antiasthmatic An agent that relieves the spasm of asthma.
Antiatherosclerotic Preventing the formation of plaques containing cholesterol, lipoid material, and lipophages within the intima and inner media of large and medium-sized arteries.
Anticholesterolemic Promoting a reduction in cholesterol levels in the blood.
Anticoagulant Any substance that prevents blood clotting.
Anticonvulsant An agent that prevents or relieves convulsions.
Antidiabetic An agent that prevents or alleviates diabetes.
Antifungal Destructive to fungi, or suppressing their reproduction and growth; effective against fungal infections.
Antihistamine A drug that counteracts the action of histamine.
Antihypercholesterolemic Effective in decreasing or preventing an excessively high level of cholesterol in the blood.
Antihyperglycemic An agent that counteracts high levels of glucose in the blood.
Antihyperlipemic An agent that prevents an elevated concentration of triglycerides in the blood.
Antihypertensive An agent that reduces abnormally high blood pressure.
Antihypotensive An agent that counteracts abnormally low blood pressure.
Anti-implantation Preventing the attachment of the blastocyst to the epithelial lining of the uterus, its penetration through the epithelium, and in humans, its embedding in the compact layer of the endometrium, beginning six or seven days after fertilization.
Anti-inflammatory An agent that counteracts or suppresses the inflammatory process.
Antilithic Preventing the formation of stone or calculus.
Antimutagenic A substance that antagonizes the mutagenic effects of other substances.
Antimycobacterial An agent that is effective against mycobacteria.
Antioxidant An agent that prevents or delays deterioration by the action of oxygen in the air.
Antiphlogistic An agent that counteracts inflammation and fever.
Antiradiation An agent capable of counteracting the effects of radiation, effective against radiation injury.
Antisickling Preventing the development of sickle cells in the blood, as in sickle cell anemia.
Antispasmodic An agent that relieves spasms, usually of smooth muscle, as in arteries, bronchi, intestine, bile duct, ureters or sphincters, but also of voluntary muscle.
Antispermatogenic A substance that reduces the production of semen or spermatozoa.
Antithiamine Counteracting the effect of the vitamin thiamine, a deficiency of which can result in beri-beri.

Antithyroid Counteracting the functioning of the thyroid, especially in its synthesis of thyroid hormone.
Antitoxic Effective against a poison.
Antitumor Counteracting tumor formation.
Aphrodisiac Any drug that arouses the sexual instinct.
Arrhythmia Any variation from the normal rhythm of the heartbeat; it may be an abnormality of either the rate, regularity, or site of impulse origin or the sequence of activation.
Arthralgic Pertaining to pain in a joint.
Ascospore A sexual spore formed within a special sac, or ascus, as in ascomycetous fungi.
Aspergillus flavus A mold found on corn, peanuts, and grain; it produces aflatoxin.
Aspergillus fumigatus A thermotolerant fungus growing in soils and manure. It has been found in infections of the ear, nose, lungs and other organs of humans and animals, and is considered to be a primary pathogen of birds; inhalation of its spores in contaminated barley dust causes malt worker's lung. Its cultures produce various antibiotics, such as fumagillin and helvolic acid.
Aspergillus niger A species of fungus common in soil and often isolated from otomycosis; it may produce a severe and very persistent infection.
Avidin A protein from egg whites that binds biotin, rendering it unavailable for absorption, and resulting in biotin deficiency if large quantities of raw egg whites are ingested.
Bacillus cereus A sometimes motile, aerobic or facultatively anaerobic spore-forming bacteria that is a common soil saprophyte. It causes food poisoning by the formation of an enterotoxin in contaminated foods.
Bacillus subtilis A common saprophytic soil and water bacteria, often occurring as a laboratory contaminant and occasionally causing conjunctivitis in humans. It produces the antibiotic bacitracin.
Bacteroides fragalis A group of closely bile-resistant, saccharolytic organisms. It is the numerically dominant species found in the human intestine and is the most commonly encountered anaerobic bacteria in clinical specimens. It is present normally in the mouth, throat, and vaginal tract. Organisms in this species are more resistant to antibiotics than any other anaerobe.
Bacteroides melaninogenicus A bile sensitive saccharolytic coccoid species that produces a black hematin pigment, part of the normal flora of the mucus membranes. It is also an important pathogen in oral, lung, and brain abscesses and occurs in other mixed infections.
Bacteroides vulgatus One of the species of bacteria most frequently isolated from fecal specimens, and it has occasionally been isolated from human infections.
Beta-hexosaminidase A specific enzyme named for specific amino sugars and linkages that are potential substrates.
Biliary Pertaining to the bile, to the bile ducts, or to the gallbladder.
Biotinylated Molecules incorporated with biotinyl groups.
Bombyx mori The silkwork used extensively in experimental genetics.
Bronchial Pertaining to one or more bronchi.
Bronchitis Inflammation of one or more bronchi.
Bronchodilator An agent that causes expansion of the lumina of the air passages of the lungs.
Calculi Abnormal concretion occurring within the animal body and usually composed of mineral salts.
Candida albicans A species of yeast-like imperfect fungi characterized by producing yeast cells, mycelia, pseudomycelia, and blastospores. It is commonly part of the normal flora of the skin, mouth, intestinal tract, and vagina, but can cause a variety of

infections. It is the most frequent agent of candidiasis.

Carcinogenesis The production of carcinoma.

Carcinoma A malignant new growth made up of epithelial cells tending to infiltrate the surrounding tissues and give rise to metastases.

Cardiac Pertaining to the heart.

Cardiovascular Pertaining to the heart and blood vessels.

Carminative A medicine that relieves flatulence and assuages pain.

Catarrh Inflammation of a mucous membrane, with a free discharge; especially such inflammation of the air passages of the head and throat.

Cervical Pertaining to the neck, or to the neck of any organ.

Chloretic An agent that accelerates the flow of bile.

Cholesterol The precursor of bile acids and steroid hormones and a key constituent of cell membranes, mediating their fluidity and permeability. Most is synthesized by the liver and other tissues, but some is absorbed from dietary sources, with each kind transported in plasma by specific lipoproteins.

Chronotrophic Affecting the time or rate, as the rate of contraction of the heart.

Cicatrization The formation of a scar.

Citrobacter freundii A species of gram-negative, facultatively anaerobic, rod-shaped bacteria that is able to use citrate as a sole carbon source. The species is not inhibited by potassium cyanide and is found in soil, water, sewage, and food, in clinical specimens from normal persons, and as an opportunistic pathogen.

Cladosporium werneckii A species of chiefly saprophytic dematiaceous imperfect fungi. It causes tinea nigra; because it is highly variable, some authorities assert that several species are involved.

Clostridium paraputrificum A species of obligate anaerobic or microaerophilic, gram-positive, spore-forming, rod-shaped bacteria commonly found in soil and feces.

Clostridium perfringens A species of obligate anaerobic or microaerophilic, gram-positive, spore-forming, rod-shaped bacteria. It is the most common agent of gas gangrene, differentiable, on the basis of the distribution of 12 different toxins, into several different types: *type A* causes gas gangrene, necrotizing colitis, and food poisoning in humans; *type B* causes lamb dysentery; *type C* causes enteritis necroticans in man and struck in sheep; *type D* causes enterotoxemia in sheep; *type E* causes enterotoxemia in lambs and calves.

Coagulant promoting, accelerating, or making possible the clotting of blood.

Colic Acute abdominal pain; characteristically, intermittent visceral pain with fluctuations corresponding to smooth muscle peristalsis.

Contraceptive An agent that diminishes the likelihood of or prevents conception.

Cyclooxygenase An activity of prostaglandin synthase.

Cytotoxic Exhibiting a specific destructive action on certain cells or the possession of such action; used particularly in referring to the lysis of cells by immune phenomena and to antineoplastic drugs that selectively kill dividing cells.

Debaryomyces hansenii A species of fungus that changes sugars into oxalic acid.

Decoction A medicine or other substance prepared by boiling.

Depressant An agent that reduces functional activity and vital energies in general by producing muscular relaxation and diaphoresis.

Diabetes A general term referring to disorders characterized by excessive urine excretion, as in diabetes mellitus and diabetes inispidus. When used alone, the term refers to diabetes mellitus.

Diuretic An agent that promotes the excretion of urine.

Dropsy Massive generalized edema.

Dysentery Any of various disorders marked by inflammation of the intestines, especially of the colon, and attended by pain in the abdomen, tenesmus, and frequent stools containing blood and mucus.

Edema The presence of abnormally large amounts of fluid in the intercellular tissue spaces of the body; usually applied to demonstrable accumulation of excessive fluid in the subcutaneous tissues. Edema may be localized, because of venous or lymphatic obstruction or to increase vascular permeability, or it may be systemic because of heart failure or renal disease.

Embryotoxic Any agent that is destructive to the fertilized ovum that eventually become the offspring during the period of most rapid development; in humans from the end of the second week after fertilization to the end of the eighth week.

Emmenagogue An agent or measure that induces menstruation either by acting directly upon the reproductive organs or by relieving another condition of which amenorrhea is a secondary result.

Enterococcus faecalis A gram-positive, facultatively anaerobic bacteria that is a normal inhabitant of the human intestinal tract; it causes urinary tract infections, infective endocarditis, and bacteremia that is often fatal. Also called *Streptococcus faecalis*.

Entobacter cloacae A species of gram-negative, facultatively anaerobic rod-shaped bacteria. It is found in feces, soil, and water and, less commonly, in urine, pus, and pathological material.

Ephelides Freckles.

Epilepsy Any of a group of syndrome characterized by paroxysmal transient disturbances of the brain function that may be manifested as episodic impairment or loss of consciousness, abnormal motor phenomena, psychic or sensory disturbances, or perturbation of the autonomic nervous system.

Epistasis Suppression of a secretion of excretion, as of blood, menses, or lochia. In genetics, the superimposition of one hereditary character upon one that is unexpressed or masked.

Erysipelas An acute superficial form of cellulites involving the dermal lymphatics, usually caused by an infection with group A streptococci, and chiefly characterized by a peripherally spreading hot, bright red, edematous, brawny, infiltrated, and sharply circumscribed plaque with a raised indurated border.

Escherichia coli The principal species of the genus and the predominant organism of the intestine of humans and animals. It is usually non-pathogenic, but pathogenic strains producing pyogenic infections and diarrhea are common. The pyogenic strains are found in infections in the urinary tract, abscesses, conjunctivitis, and occasionally septicemia, such as hemorrhagic septicemia in newborn infants. The enteropathogenic strains produce intestinal disease, especially in hospitalized infants. It causes diarrhea in piglets and calves, and a cholera-like disease in human infants and adults. It invades the epithelial cells of the human colon, causing dysentery, sometimes associated with food poisoning. It often becomes the predominant bacteria in the flora of the mouth and throat during antibiotic therapy.

Eubacterium lentum A nonsporulating, gram-positive, anaerobic, rod-shaped bacteria found as a saprophyte in soil and water. It is a normal inhabitant of the skin and cavities of humans and other mammals, occasionally causing infections of soft tissues.

Eubacterium limosum A nonsporulating, gram-positive, anaerobic, rod-shaped bacteria that synthesizes vitamin B_{12}. It has been isolated from the feces of humans and other animals, from human infections, and from mud.

Expectorant An agent that promotes the ejection of mucus or exudate from the

lungs, bronchi, and trachea; sometimes extended to all remedies that quiet cough (antitussives).

Fibrinogen A fraction of normal human plasma, when in solution, has the property of being converted into soluble fibrin when thrombin is added; administered by intravenous infusion to increase the coagulability of the blood.

Fibrinolytic An agent that causes the dissolution of fibrin by enzymatic action.

Fluidextract A liquid preparation of a vegetable drug prepared by percolation, containing alcohol as a solvent or as a preservative, or both, of such strength that each milliliter contains the extraction of 1 gm of the standard drug which it represents.

Furuncles A painful nodule formed in the skin by circumscribed inflammation of the corium and subcutaneous tissue, enclosing a central slough or "core". It is caused by staphylococci, which enter through the hair follicles, and its formation is favored by constitutional or digestive derangement and local irritation.

Fusarium oxysporum A species of imperfect fungi. This species is frequently associated with mycotic keratitis, often destroying the eye. It also causes banana wilt.

Fusobacterium nucleatum A gram-negative, anaerobic, non-sporulating bacteria isolated from the normal mouth, the upper respiratory, genital, and gastrointestinal tracts and infections of the mouth, lungs, and brain. It is the organism most commonly found, in association with spirochetes (*Treponema vincentii*), in acute necrotizing gingivitis. It is also called *Bacillus fusiformis*.

Galactagogue An agent that promotes the flow of milk.

Gastralgia Gastric colic.

Geotrichum candidum A species of yeast-like imperfect fungi found in the feces and in dairy products. It is the etiologic agent of geotrichosis.

Gluconeogenesis The formation of glucose from molecules that are not themselves carbohydrates, as from amino acids, lactate, and the glycerol portion of fats.

Glucose-6-phosphatase An enzyme that catalyzes the dephosphorylation of glucose 6-phosphate. It occurs in the endoplasmic reticulum of liver, kidney, and intestinal mucosa, but not in muscle, and its reaction is the principal route of hepatic gluconeogenesis, controlling blood glucose concentrations.

Glutamate pyruvate transaminase An enzyme that catalyzes the reversible transfer of an amino group from alanine to alpha-ketoglutarate to form glutamate and pyruvate. The enzyme is found in serum and body tissues, especially in the liver. Serum enzyme activity (SGPT) is greatly increased in liver diseases and also elevated in infectious mononucleosis.

Glutathione A tripeptide that is widely distributed in animal and plant tissues. It functions in various reactions such as the destruction of peroxides and free radicals, as a cofactor for enzymes, and in the detoxification of harmful compounds. Glutathione is also involved in the transport of amino acids across cell membranes and in the formation and maintenance of disulfide bonds in proteins.

Goiter An enlargement of the thyroid gland, causing a swelling in the front part of the neck.

Goitrogenic Producing goiter.

Hansenula anomala A nonpathogenic species of yeast commonly found in soil and in the respiratory and intestinal tracts.

Hematinic An agent that improves the quality of the blood, increasing the hemoglobin level and the number of erythrocytes.

Hemotoxic An agent that is poisonous to the formation of the blood cells and to the blood.

Hypercalcemia An excess of calcium in the blood; manifestations include fatigabil-

ity, muscle weakness, depression, anorexia, nausea, and constipation.

Hypercholesterolemic An agent that pertains to, characterized by, or tends to produce an excess of cholesterol in the blood.

Hyperglycemic Pertaining to, characterized by, or causing an increase in the level of glucose in the blood.

Hyperlipemia A general term for the elevated concentrations of any or all of the lipids in the plasma.

Hypertension High arterial pressure. Various criteria for its threshold have been suggested, ranging from 140 mm Hg systolic and 90 mm Hg diastolic, to 200 mm Hg systolic and 110 mm Hg diastolic. Hypertension may have no known cause (idiopathic of essential) or be associated with other primary diseases (secondary).

Hypertensive An agent that is characterized by or causes increased tensions or pressure, as abnormally high blood pressure.

Hypocholesterolemic Pertaining to, characterized by, or producing an abnormally diminished amount of cholesterol in the blood.

Hypoglycemia An abnormally diminished concentration of glucose in the blood, which may lead to tremulousness, cold sweat, piloerection, hypothermia and headache, accompanied by irritability, confusion, hallucinations, bizarre behavior, and ultimately, convulsions and coma.

Hypoglycemic An agent that acts to lower the level of glucose in the blood.

Hypolipemia An abnormally decreased amount of fat in the blood.

Hypotension Abnormally low blood pressure as seen in shock, but not necessarily indicative of it.

Hypotensive Characterized by, or causing diminished tension or pressure, as abnormally low blood pressure.

Hypothermic Pertaining to or exhibiting reduced body temperature.

Immunosuppressant An agent capable of suppressing immune responses.

Inosine An intermediate in the degradation of purines and purine nucleosides to uric acid.

Intra-aural Within the ear.

Intragastric Situated or occurring within the stomach.

Intraperitoneal Within the peritoneal cavity.

Intravaginal Within the vagina.

Jaundice A syndrome characterized by hyperbilirubinemia and deposition of bile pigment in the skin, mucus membranes and sclera with resulting yellow appearance of the patient.

Klebsiella pneumonia A gram-negative, facultatively anaerobic, non-motile bacteria that is found in soil, water, and grain, in the intestinal tract of humans and animals, and in association with infections of the urinary and respiratory tracts. It is the etiologic agent of acute bacterial pneumonia.

Kluyveromyces fragalis A gram-negative, facultatively anaerobic, rod-shaped bacteria occurring in human clinical specimens. It is an occasional opportunistic pathogen, causing respiratory and urinary infections.

Lacrymation The secretion and discharge of tears.

Lactate dehydrogenase An enzyme that catalyzes the reduction of pyruvate to lactate. The reaction is the final step in glycolysis. The reverse reaction is the first step in the combustion of lactate in the heart or its conversion to glucose in the liver. It occurs in the cytoplasm of nearly all cells and its presence in serum is used for clinical diagnosis.

Leukocytes White blood cells or corpuscles. The varieties are classified into two main groups: granular and nongranular.

Lipemia A general term for the elevated concentrations of any or all of the lipids in the plasma.

Lipolytic Pertaining to, characterized by, or causing the decomposition or splitting up of fat.

Lipoxygenase An enzyme that catalyzes the oxidation of lineolate and related polyunsaturated fatty acids to their hydroperoxide forms.

Lochia The vaginal discharge that takes place during the first week or two after childbirth.

Lyophilized The creation of a stable preparation of a substance by rapid freezing and dehydration of the frozen product under high vacuum.

Melasma Hypermelanosis characterized by the development of sharply demarcated blotchy, brown macules usually in a symmetric distribution over the cheeks and forehead and sometimes on the upper lip and neck. It frequently occurs during pregnancy, at menopause, and in those taking oral contraceptives and sometimes in men. A similar pattern of facial hyperpigmentation may be associated with chronic liver disease.

Metastasis The transfer of disease from one organ or part to another not directly connected with it.

Micrococcus luteus A spherical, gram-positive, aerobic bacteria of extremely small size, usually occurring in irregular masses. It is saprophytic and non-pathogenic and is found in soil, water, dust, and dairy products.

Micronuclei The smaller types of nuclei when more than one are present in a cell. In ciliate protozoa, the transcriptively inert, diploid nucleus, much smaller than the macronucleus, that is involved in reproduction.

Microsporum canis A fungus that is the common cause of ringworm in cats and dogs; often transmitted to children, in whom it causes tinea capitis and tinea corporis. It is also probably the cause of a dermatomycosis in horses.

Mitomycin C An antineoplastic antibiotic produced by *Streptomyces caespitosus* that acts as a bifunctional or trifunctional alkylating agent causing cross-linking of DNA and inhibition of DNA synthesis, and is relatively phase-specific for the late G_1 and early S phases of the cell cycle. It has activity against carcinomas of the stomach, pancreas, colon, rectum, breast, lung, and head and neck, as well as chronic myelogenous leukemia.

Mutagenic Causing change or inducing genetic mutation.

Mutagenicity The property of being able to induce mutation.

Mutation A change in form, quality, or some other characteristic. In genetics, a permanent transmissible change in the genetic material, usually a single gene.

Mycobacterium phlei A gram-positive, aerobic, rapid growing, photochromogenic, nonpathogenic species found in grasses and soil.

Mycobacterium tuberculosis A gram-positive, slow-growing, nonphotochromogenic, pathogenic species that is the causative agent of tuberculosis in man, other primates, dogs, guinea pigs, and hamsters.

Natriuretic An agent that promotes the excretion of sodium in the urine.

Necrosis The sum of the morphological changes indicative of cell death and caused by the progressive degradative action of enzymes; it may affect groups of cells or part of a structure or an organ.

Neutrophil A granular leukocyte having a nucleus with three to five lobes connected by slender threads of chromatin, and cytoplasm containing fine inconspicuous granules; neutrophils have the properties of chemotaxis, adherence to immune complexes, and phagocytosis.

Nucleotidase An enzyme that catalyzes the cleavage of a nucleotide to a nucleoside and orthophosphate.

Oleoresin Any natural combination of a resin and a volatile oil such as exudes from plants. A compound prepared by exhausting a drug by percolation with a volatile

solvent, such as acetone, alcohol, or ether, and evaporating the solvent.

Ophthalmic Pertaining to the eye.

Oxytocin One of the major hormones made in the magnocellular hypothalamic neurons and stored in the posterior lobe of the pituitary. It has uterine-contracting and milk-ejecting actions.

Pancreatectomized Surgical removal of the pancreas gland.

Pasteurella pestis (*Yersinia pestis*) A gram-negative, facultatively anaerobic, rod-shaped to ovoid bacteria. It is etiologic agent of the bubonic and pneumonic plague in humans and rats, ground squirrels, and other rodents, transmitted from rat to rat and from rat to man by rat flea, and from man to man by the human body louse.

Pathogenic Giving origin to disease or to morbid symptoms.

Peptostreptococcus productus A gram-positive, obligately anaerobic, chemo-organotrophic bacteria with spherical cells, occurring in chains. It is isolated from cases of gangrene and pelvic abscesses and from blood and urine.

Phorbol ester The ester of a polycyclic alcohol that is structurally similar diacylglycerol and can activate protein kinase C. They are used in research to enhance the induction of mutagenesis or tumors by carcinogens.

Placenta A fetomaternal organ characteristic of true mammals during pregnancy, joining mother and offspring, providing endocrine secretion and selective exchange of soluble, blood-borne substances through an apposition of uterine and trophoblastic vascularized parts.

Platelet aggregation Clumping together of platelets as part of a sequential mechanism leading to the initiation and formation of a thrombus or hemostatic plug.

Platelet Disc-like structure, 2 to 4 mm in diameter, found in the blood of all mammals and chiefly known for its role in blood coagulation.

Polyamine Any compound containing two or more amine groups; polyamines are low molecular weight cations and are synthesized within cells to provide intermediates for protein synthesis.

Propionibacterium acnes A non-spore-forming, anaerobic or aerotolerant, gram-positive bacteria that is a normal inhabitant of the skin and a frequent contaminant of anaerobic cultures. It is a potential pathogen associated with chronic infections in the blood and bone marrow.

Prostaglandin Any of a group of components derived from unsaturated 20-carbon fatty acids, primarily arachidonic acid, via the cyclooxygenase pathway; they are extremely potent mediators of a diverse group of physiologic processes.

Proteus vulgaris A gram-negative, facultatively anaerobic, rod-shaped bacteria found in fecal matter, sewage, and soil. It is a common cause of cystitis and pyelonephritis and is associated with eye and ear infections, pleuritis, peritonitis, and suppurative abscesses. The species has many serotypes and reacts with antibodies formed in rickettsial infections, and is used in the Well-Felix reaction for the diagnosis of typhus, scrub typhus, and Rocky Mountain spotted fever.

Pseudomonas aeruginosa A gram-negative bacteria that produce pyocyanin and fluorescein, which give the color to "blue pus" observed in certain suppurative infections. It is a major agent that causes severe and often fatal infections most commonly involving the urinary tract, wounds, abscesses, or the blood stream; it may also cause eye infections in those who use contact lenses.

Purine A compound ($C_5H_4N_4$) that is not found free in nature, but is variously substituted to produce a group of compounds known as *purines*, of which uric acid is a metabolic end product.

Pyrolysis Decomposition of organic substances under the influence of a rise in temperature.

Rheumatic Pertaining to or affected with any of a variety of disorders marked by inflammation, degeneration, or metabolic derangement of the connective tissue structures, including muscles, bursae, tendons and fibrous tissue.

Rhinoconjunctivitis Inflammation of the mucus membranes of the nose and eyes.

Rhodotorula rubra A species of imperfect yeast that contaminates the skin but rarely cause opportunistic infections in man.

Saccharomyces cerevisiae A yeast-like fungi with oval or spherical cells, known as *brewers'* or *bakers' yeast*; it causes alcoholic fermentation, and is a very rare cause of lung disease.

Salmonella typhosa A gram-negative, facultatively anaerobic bacteria that is a strict parasite of humans and the cause of typhoid fever. The organism is transmitted by water or food contaminated by human excreta.

Sarcoma Any of a group of tumors usually arising from connective tissue, although the term now includes some of epithelial origin; most are malignant. Many types have prefixes denoting the type of tissue or structure involved.

Scurvy A condition due to deficiency of ascorbic acid (Vitamin C) in the diet and marked by weakness, anemia, spongy gums, a tendency to mucocutaneous hemorrhages and a brawny induration of the muscles of the calves and legs.

Serratia marcescens A gram-negative, facultatively anaerobic bacteria with red-pigmented varieties, occurring in water, soil, and food and in clinical specimens. It is an opportunistic pathogen, causing nosocomial bacteriemia, endocarditis, and pneumonia in immunocompromised patients.

Spermicidal Destructive to spermatoza.

Staphylococcus aureus A gram-positive, facultatively anaerobic bacteria comprising the yellow-pigmented, coagulase-positive pathogenic forms of the genus, causing serious suppurative infections and systemic disease; it produced toxins that cause food poisoning and toxic shock syndrome. Also called *S. pyogenes*.

Strangury Slow and painful discharge of urine, due to spasm of the urethra and bladder.

Streptococcus faecalis See *Enterococcus faecalis*.

Streptococcus mutans A species of the viridans group with variable hemolysis. It has been implicated in the formation of dental caries.

Streptococcus pyogenes A species of β-hemolytic, toxigenic pyogenic streptococci causing septic sore throat, rheumatic fever, puerperal sepsis, acute glomerulonephritis, and other conditions in man.

Streptococcus sanguis A gram-positive, facultatively anaerobic, α-hemolytic bacteria of the viridans grroup. It is found in humans in dental plaque, in blood, and in subacute bacterial endocarditis.

Streptococcus thermophilus An α-hemolytic species of the viridans group found in milk and milk products.

Streptococcus viridans A group of α-hemolytic streptococci that have no defined group antigens found as part of the normal flora of the respiratory tract; streptococci of this group cause dental caries and bacterial endocarditis.

Subcutaneous Beneath the skin.

Supernatant Situated above or on top of something. The overlying liquid after precipitation of a solid component.

Superoxide Any compound containing the highly reactive superoxide radical O_2^-, which is produced by reduction of molecular oxygen in many biological oxidations; this highly toxic free radical is continuously removed by the enzyme superoxide dismutase.

Sympathomimetic An agent that produces effects similar to those of impulses conveyed by adrenergic postganglionic fibers of the sympathetic nervous system.

Thromboxane Either of two compounds, thromboxane A_2 (TXA_2) or thromboxane B_2 (TXB_2); TXA_2 is an extremely potent inducer of platelet aggregation and platelet release reactions and is also a vasoconstrictor. It is synthesized by platelets and is very unstable, undergoing nonenzymatic hydrolysis to TXB_2, which is inactive, with a half-life of 30 seconds.

Tincture An alcoholic or hydroalcoholic solution prepared from biological substances or from chemical substances.

Tinea versicolor A common chronic, noninflammatory and usually symptomless disorder, characterized only by occurrence of multiple macular patches, of all sizes and shapes, varying from whitish in pigmented skin to fawn –colored or brown in pale skin. It is seen most frequently in hot, humid tropical regions and is caused by *Malassezia furfur*.

Titer The quantity of a substance required to produce a reaction with a given volume of another substance, or the amount of one substance required to correspond with a given amount of another substance.

Tolbutamide A sulfonylurea compound used as a hypoglycemic in the treatment of non-insulin-dependent diabetes mellitus.

Torulopsis glabrata A species of imperfect fungi which is morphologically similar to *Cryptococcus* but do not have a capsule, and are normal flora of the mouth, gut, and urinary tract.

Toxacara canis A nematode worm parasitic in the intestine of dogs; migrating larvae may cause lesions of the lung, liver, kidney, brain, and eye. In human infections, the larvae do not complete their cycle, but cause visceral larva migrans.

Trichophyton mentagrophytes A species of imperfect fungi that attacks the skin, nails, and hair.

Trichophyton rubrum A species of imperfect fungi that attacks the skin, nails, and hair.

Trichophyton tonsurans A species of imperfect fungi that attacks the skin, nails, and hair.

Triglyceride A compound consisting of three molecules of fatty acid esterified to glycerol; it is a neutral fat synthesized from carbohydrates for storage in animal adipose cells. On enzymatic hydrolysis, it releases free fatty acids in the blood.

Trophoblast A layer of extraembryonic ectodermal tissue on the outside of the blastocyst. It attaches the ovum to the endometrium of the uterine wall and supplies nutrition to the embryo. From it are derived the chorion and amnion.

Uric acid The end product of purine catabolism in primates. Urate is very insoluble in water, and disorders of purine metabolism produce gout, in which deposition of sodium urate crystals in the joints and skin is followed by a foreign-body inflammatory response.

Uricosuric An agent that promotes the excretion of uric acid in the urine.

Urinary Pertaining to the urine; containing or secreting urine.

Ustilago maydis A fungus causing corn smut; the ingestion of infected seeds causes ustilaginism, a condition similar to ergotism.

Whitlow A primary infection of the terminal segment of a finger, usually occurring in persons exposed to infected oral or respiratory secretions. It begins with intense itching and pain, followed by the formation of deep coalescing vesicles. The process is associated with much tissue destruction and may be accompanied by systemic symptoms.

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